



Geotechnical
Environmental
Water Resources
Ecological

July 11, 2014

Project No. 1323080

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Special Projects Branch
Bureau of Corrective Actions
Nevada Division of Environmental Protection
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Re: Titanium Metals Corporation
Henderson, Nevada Facility
NDEP Facility ID # 000537
Conceptual Site Model

Dear Mr. Friend:

GEI Consultants is pleased to submit the above-captioned document on behalf of the Titanium Metals Corporation (TIMET).

If you have any questions regarding this submittal, please do not hesitate to contact the undersigned at (716) 204-7158 (email: kmcintosh@geiconsultants.com) or Mr. Richard Pfarrer of TIMET at (702) 566-4453 (email: Richard.Pfarrer@Timet.com).

Sincerely,

GEI Consultants, Inc.

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Conceptual Site Model

Titanium Metals Corporation
Henderson, Nevada

Submitted to:

Titanium Metals Corporation
Henderson, New York

Submitted by:

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July 2014

Project 1323080

JURAT

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and to the best of my knowledge comply with all applicable federal, state and local statutes, regulations and ordinances.

For the services provided and attested to with this Jurat including implementation of the CSM Supplemental Investigation Work Plan and preparation of this Conceptual Site Model Report.

GEI CONSULTANTS, INC.

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Date Signed: July 11, 2014

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Attachments

- 1 Hydrogeologic Testing Report (Golder 2006)
- 2 Hydrogeologic Testing Report (Golder 2008)
- 3 Waste Stream Analytical Reports
- 4 Site-Related Chemical List
- 5 CSM Boring Logs
- 6 Data Validation Summary Reports for CSM Supplemental Investigation

ACRONYMS AND ABBREVIATIONS

AST	Aboveground Storage Tank
BCLs	Basic Comparison Levels
bgs	below ground surface
BMI	Black Mountain Industrial
BRC	Basic Remediation Company
BWPC	Bureau of Water Pollution Control
CAB	Cation-Anion balance
CAS	Chemical Abstract System
CEM	Certified Environmental Manager
CMT	Continuous Multi-channel Tubing
CSD	Continuous Sludge Dryer
CSM	Conceptual Site Model
DAF	Dilution Attenuation Factor
DAQEM	Department of Air Quality and Environmental Management
ECA	Environmental Conditions Assessment
ECI	Environmental Conditions Investigation
ECIA	Environmental Conditions Investigation Addendum
GCL	Geosynthetic Clay Liner
GSA	General Services Administration
HAP	Hazardous Air Pollutant
LBCLs	Leaching Based Comparison Levels
LOU	Letter of Understanding
MCf	Muddy Creek Formation
xMCf	Transitional Muddy Creek Formation
fMCf	Fine-Grained Muddy Creek Formation
cMCf	Coarse-Grained Muddy Creek Formation
UMCf	Upper Muddy Creek Formation
mgd	million gallons per day
mg/kg	milligram per kilogram
MNA	Monitored Natural Attenuation
NAC	Nevada Administrative Code
NCCW	Non-Contact Cooling Water
NDEP	State of Nevada Division of Environmental Protection
NERT	Nevada Environmental Response Trust
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and maintenance

OPW	Other Process Water
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PCE	Tetrachloroethene
pdf	portable data format
PSA	Potential Source Area
Qal	Quaternary Alluvium
QC	Quality Control
RAIS	Risk Assessment Information System
RAO	Remedial Action Objectives
RAWP	Remedial Action Work Plan
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
SRC	Site-Related Chemical
SVOC	Semi-Volatile Organic Compounds
TCE	Trichloroethene
TDS	Total Dissolved Solids
TIMET	Titanium Metals Corporation
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSCA	Toxic Substances Control Act
TTHM	Total Trihalomethanes
µg/L	micrograms per liter
U	Estimated
USCS	Unified Soil Classification System
VOC	Volatile Organic Compounds
VDP	Vacuum Distillation Process
WAPA	Western Area Power Administration
WBZ	Water-bearing Zone
WCF	Water Conservation Facility

1. Introduction

GEI Consultants (GEI) has been retained by Titanium Metals Corporation (TIMET) to prepare this Conceptual Site Model (CSM) for TIMET's facility (Facility or Site) located in Henderson, Nevada (Figure 1-1).

1.1 Purpose and Scope

This document follows the guidelines set forth in ASTM International's "Standard Guide for Developing Conceptual Site Models for Contaminated Sites" (ASTM International 2008). This CSM is intended to achieve the following objectives:

1. Integrate technical information from multiple sources
2. Identify data gaps additional data needs
3. Evaluate (qualitatively) the risk to human health and the environment posed by the TIMET site.

The purpose of the CSM is to describe the Site and to identify and assess potential sources of chemical release to the environment, transport pathways, exposure routes and receptors. The CSM will evaluate the completeness of the available information and identify additional data requirements as appropriate. If the available information is sufficient to support development of remedial actions, the CSM will identify Remedial Action Objectives (RAO) and identify and evaluate remedial actions intended to reduce the exposure of environmental receptors to contaminants. If the available information is sufficient for a determination that no further action is needed for a given potential source or area of the Facility, a request to the State of Nevada Division of Environmental Protection (NDEP) for such determination will be made in a separate follow-up submittal to NDEP.

The CSM is based on previous investigative work conducted at the Site as presented in the 2007 CSM Report (TIMET 2007b) supplemented with additional investigations conducted by TIMET during 2013-2014. NDEP Comments on the 2007 CSM Report were considered when designing the work plan for the 2013-2014 investigation activities.

Following submittal of the 2007 CSM Report, remedial actions directed by NDEP have been implemented at the site. These actions include: 1.) the excavation of contaminated sediments and soil impacted by the Beta Ditch/Northwest Ditches; 2.) excavation of soil impacted by the former Francy's Mountain and; 3.) implementation of the groundwater remediation program for the First Water-Bearing Zone (First WBZ). Further, under NDEP oversight, TIMET is installing a geosynthetic clay liner (GCL) cover over several former areas in which environmental impacts

were found. In this CSM, the effectiveness of these remedial actions are taken into consideration in the evaluation of environmental impacts, transport routes and potential exposures associated with the Site.

1.2 Report Organization

The CSM includes the following eleven numbered sections and six attachments:

1.0 Introduction – Presents the general purpose and scope of the CSM

2.0 Site Setting – Presents the physical and hydrogeologic setting of the Site and surrounding area.

3.0 Historical Information – Summarizes the historical uses of the Site and its environmental regulatory and investigation history.

4.0 Site Operations – Summarizes the operations and environmental practices at the Facility and lists Potential Source Areas (PSAs) identified by TIMET and NDEP.

5.0 Site Remediation Summary – Describes environmental remediation programs implemented prior to submittal of this CSM.

6.0 Site Investigation Summary – Describes environmental investigations upon which the CSM is based.

7.0 Conceptual Site Model – Assesses the sources, migration routes and potential for exposure to chemicals released at the Site.

8.0 RAOs and TIMET Site Remediation: Presents a preliminary assessment of the degree to which the remediation systems (constructed and planned) attain RAOs.

9.0 Data Gaps – Identifies data gaps that were encountered during development of the CSM.

10.0 Recommendations for Additional Investigation and Remedial Action – Presents recommendations for additional investigation and/or remediation to address complete exposure pathways.

11.0 References – Provides a bibliographic citation for each of the references in the report. *Note: Various sources of data and interpretation are cited in this CSM Report, including reports prepared by the BMI Companies and their consultants. The references to these documents contained in this CSM Report do not indicate the document cited has been approved by NDEP unless this is explicitly stated.*

Attachment 1 -- Hydrogeologic Testing Report (Golder 2006)

Attachment 2 -- Hydrogeologic Testing Report (Golder 2008)

Attachment 3 -- Waste Stream Analytical Reports

Attachment 4 -- Site-Related Chemical List

Attachment 5 -- CSM Boring Logs

Attachment 6 -- Data Validation Reports for CSM Supplemental Investigation
(electronic files on DVD)

1.3 Facility Location

The TIMET facility is part of the Black Mountain Industrial (BMI) Complex located in the City of Henderson, Clark County, Nevada. Figure 1-2 shows the location of the TIMET facility. The study area of the CSM is broadly defined as the TIMET property (Plant Site) and off-site areas which were identified as potential exposure pathways. Figure 1-3 shows the Plant Site and surrounding areas.

1.4 Site Features

The TIMET Plant Site comprises 108 acres and includes several buildings and materials management areas. A composite list of active and inactive facility features at the Plant Site is provided below and shown on Figure 1-3.

The TIMET Plant Site comprises 108 acres and includes several buildings and material management areas. A composite list of active and inactive facility features at the Plant Site is provided below and shown on Figure 1-3.

- Administrative Buildings
- Process and Manufacturing Buildings
- Maintenance Operations
- Landfills
- Material and Equipment Storage Areas
- Retention/Evaporation Ponds and Tanks
- Interior and Perimeter Roadways and Rail

Features of the TIMET Plant Site are described in detail in the Phase I Environmental Conditions Assessment (ECA) Report (Law Engineering, Inc. 1993) and the Final Phase II Environmental Conditions Investigation (ECI) and Draft ECI Addendum Reports (Tetra Tech 1998, 1999, respectively). This CSM addresses those site features where a potential chemical release to the environment may have occurred.

1.5 Excluded Areas

This CSM considers the contiguous portions of the TIMET Facility (Figure 1-3). Areas that are not or are partially addressed in this CSM are discussed below.

1.5.1 TRECO

The TRECO property consists of approximately 73 acres south of the TIMET Site that were formerly owned by TIMET (Figure 1-2). In order to commercially develop the TRECO property, Basic Remediation Company (BRC) conducted environmental investigations in 2005. Twenty-two soil borings were installed, with samples collected at the surface, 5 feet below ground surface (bgs), and 10 feet bgs. Samples were analyzed for inorganic ions, metals, volatile organic compounds (VOCs), radionuclides, semi-volatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), dioxins and furans, polychlorinated biphenyls (PCB), and pesticides. Results of the investigation were analyzed and assessed for risk to future commercial occupants in the Basic Environmental Company's Risk Assessment Report, dated October 2005. Based upon the reported findings, NDEP granted the request for a determination of No Further Action (NFA) in a letter to TRECO, dated April 19, 2006. The NFA was granted with conditions; most notably, groundwater beneath the property was excluded from the NFA. TIMET has retained responsibility for addressing groundwater beneath the TRECO property. Therefore, while further consideration of TRECO soils is not included in this CSM, groundwater beneath the property is considered in this CSM.

1.5.2 Parcel F

Parcel F is a 3.76-acre property, located at the southeastern corner of the intersection of 4th Street and Avenue F, within the BMI complex on Lake Mead Parkway (Figure 1-2).

In response to TIMET's request for an NFA determination for Parcel F, NDEP requested environmental characterization in the following areas:

- Clarifier Lid Storage Area
- Former Aboveground Storage Tank (AST) Area
- Building B-7 (used to store electrical equipment)
- Former Building B-5 (used to store rutile)

Characterization activities included hand-augering and collecting samples from two soil borings near the Clarifier Lid Storage and Former AST Areas, collecting a wipe sample from the concrete floor of Building B-7, and performing a radiological survey of former Building B-5. Based upon the investigation activities, remediation activities were conducted to remove SVOCs from surface soil in the Clarifier Lid Storage Area and to remove PCBs from the concrete in Building B-7. Details of these activities are reported in the Parcel F Removal Action and Closure Report (TIMET 2006a) and the subsequent addendum (TIMET 2006b).

Former Building B-5 was destroyed in a fire in the 1970s. All that remains of Building B-5 is a sunken, asphalt-covered concrete foundation, approximately 4 feet deep, with various concrete support structures on top of the foundation.

Building B-7 is a concrete structure approximately 17.5 feet wide by 33 foot long. The walls are poured concrete and are about 7-inches thick. The foundation is over 5.5-feet thick. The electrical equipment was decommissioned and the majority of this equipment was removed from the building before 1978.

NDEP granted the request for a finding of NFA in a letter to TIMET dated November 7, 2006. However, groundwater under this area was excluded from the NFA because of reported effects from other sources in proximity to this site. Soils within Parcel F are therefore not considered further in this CSM. However, the degree to which the TIMET facility could have contributed to groundwater contamination beneath Parcel F is considered in this CSM.

1.5.3 Western Area Power Administration Basic Substation

The Basic Substation comprises 48.34 acres of land south of the processing facilities that was originally used by the former magnesium manufacturing facilities (Figure 1-3). It was constructed as the electrical substation for the original magnesium plant and continued operating to support the various manufacturing plants that followed. The Bureau of Reclamation operated the Basic Substation from 1942 until the Western Area Power Administration (WAPA) took over operation in 1976. The substation consisted of three electrical substations (Yards 1, 2, and 3), utility corridors, a rail line, a control building, an underground control cable tunnel, and transformer maintenance facilities. The control building was demolished in 2004 and the three substations aboveground facilities were dismantled in 2005. WAPA is responsible for investigation and remediation of the Basic Substation. Soils impacts are not considered further herein. Potential impacts to groundwater migrating across the TIMET property are considered.

1.5.4 Parcel E

This property consists of 6.34 acres within the BMI Complex. This site is bordered by Tronox LLC (formerly Kerr McGee Chemical Corporation) to the north and east, by MCC Development Corporation to the south, and by Pioneer/Montrose operations to the west (Figure 1-2). Because this site is not contiguous with the TIMET Plant Site it will be addressed separately.

2. Site Setting

2.1 Physiography

2.1.1 Land Use

The TIMET Plant Site is the easternmost facility of an industrial complex known as the BMI Complex. As shown on Figure 1-2, TIMET is bordered on the west by the Tronox facility (formally known as Kerr-McGee) which has been used to produce sodium perchlorate, ammonium perchlorate and other chemical products. Further to the west of Tronox, is the Olin Chemicals chlorine production (chlor-alkali) facility. The chlor-alkali facility is located on property formerly used by Montrose Chemical Corporation and Stauffer Chemical Corporation for manufacture of chlorinated aromatic compounds including a variety of pesticides. This site is referred to as the OSSM Site.

To the east and north of the TIMET Plant Site, lies existing or planned residential development. The TRECO property, to the south of the TIMET Plant Site, is used for commercial and light industrial purposes.

It is anticipated that future use of the TIMET Plant Site will remain heavy industrial as this facility is the only manufacturer of high grade titanium ingot in North America.

2.1.2 Topography

TIMET is in the Las Vegas Valley, a broad alluvial valley that occupies a structural basin in the Valley and Range Physiographic Province. The Las Vegas Valley is mostly surrounded by mountains, ranging from 2,000 to 10,000 feet higher than the valley floor. The valley floor ranges in elevation from about 3,000 feet above mean sea level (msl) in the west at the mountain front to 1,500 feet above msl in the east at the Wash (SNWA 1996). The surrounding mountain ranges are:

- Sheep Range to the north
- Frenchman and Sunrise Mountains to the east
- McCullough and River Ranges to the south
- Spring Mountains and Sierra Nevada Mountains of California to the west

The valley is about 1,550 square miles in size, and the structural and topographical axis is aligned approximately northwest to southeast. The eastern edge of the valley is about 5 miles

west of Lake Mead, a major multipurpose reservoir and drinking water source on the Colorado River.

2.1.3 Climatology

To characterize climate at TIMET, local weather observations from the meteorological monitoring station at McCarran Airport were used. McCarran Airport, at an elevation of 2,127 feet above msl, is about 5 miles south of downtown Las Vegas and about 9 miles northwest of and 300 feet higher than the TIMET Site.

Data were summarized for a period from 1981 through 2010. The Las Vegas Valley has an arid southwest climate. In the summer, daytime maximum temperatures commonly exceed 100 °F. Winters are mild, with daytime temperatures averaging 60 °F. Snow is rare. The mean annual temperature is 69 °F, and the mean daily maximum and minimum temperatures are 80 and 59 °F, respectively.

The mountains to the west of the valley act as barriers to moisture moving east from the Pacific Ocean, contributing to low precipitation and high evaporation rates. The average number of days with rainfall is 50, and the mean annual precipitation is 4.17 inches. Most precipitation occurs during the summer months of July and August and during the winter. The mountains surrounding the basin may receive up to 20 inches of precipitation per year, usually the result of snowfall. The predominant sky cover is clear (3817 annual hours of sunshine). The average wind speed is 10 knots from the southwest with southeasterly components.

Most winter precipitation is derived from frontal systems moving east from the Pacific Ocean. Rainfall is usually low-intensity and occurs over broad areas. Conversely, nearly all summer precipitation originates from infrequent local thunderstorms that move into Las Vegas Valley from the southwest. The thunderstorms are characterized by short periods of high intensity rainfall and wind speeds that can exceed 50 mph. High rates of runoff can cause local flooding. Evapotranspiration rates are very high, influenced by high temperatures, high winds, and low humidity. Evapotranspiration rates are very high, influenced by high temperatures, high winds, and low humidity. Annual potential evapotranspiration exceeds 86 inches (SNWA 1996).

2.1.4 Surface Drainage

All surface water in Las Vegas Valley is tributary to Lake Mead via the Wash (Brothers and Katzer 1988), the major drainage in the valley. The Wash collects stormwater, shallow groundwater, urban runoff, and treated sewage effluent. It is the receiving water body for all major Las Vegas area surface water discharges. According to the Las Vegas Wash Coordination Committee (based on average annual flow data from 2000), in dry weather, flow in the Wash is contributed mainly by treated effluent from the Clark County Water Reclamation District (76 million gallons per day [mgd]) and the City of Las Vegas Water Pollution Control Facility (80 mgd). The City of Henderson contributes a smaller amount (8.4 mgd). Discharge from these

sources is sufficient to maintain surface flows in the Wash throughout the year. TIMET uses the Wash as the receiving stream for once-through non-contact cooling water and treated process waters (permitted Outfalls 001 and 002 respectively).

The TIMET Plant Site is located about 2.8 miles south of Las Vegas Wash (Figure 1-1) at elevation ranging from 1,873 feet above msl at Lake Mead Drive to about 1,750 feet above msl at the northern property boundary. From the Plant Site, the land surface in this area slopes north-northeast toward the Wash at a rate of about 0.020 foot per foot (ft/ft).

At the TIMET Plant Site, the natural topography has been modified to control surface water drainage patterns in accordance with the Stormwater Pollution Prevention Plan (Golder 2002). Off-site stormwater is diverted around the Plant Site in drainage ditches. Prior to construction of the current stormwater system, open ditches crossed the northern portion of the TIMET Plant Site (see Figure 4-5). These ditches conveyed both stormwater and wastewater discharges from the BMI Complex to the Upper Ponds. These ditches were replaced by the current system to meet regulatory requirements and to reduce the potential for flooding during storm events.

Two drainage systems are present on site: a stormwater drainage system and an acid drain system. The inlets for the storm drainage are set above grade to prevent flow into the storm drain system during normal operations, and the acid drain system inlets are set at grade. All surface flow and stormwater generated on site is conveyed to the acid drain system. This system discharges to TIMET's on-site water treatment facility (referred to as the Water Conservation Facility or WCF). During a rainfall event, stormwater is diverted to and is combined with the noncontact cooling water after fifteen minutes has elapsed.

The storm drain system directs stormwater and noncontact cooling water to a Stilling Pond via the Alpha Ditch. Once through the pond, the water is discharged to the Pittman Bypass at the north end of the Plant Site. Discharges via the Pittman Bypass are regulated and monitored under TIMET's National Pollution Discharge Elimination System (NPDES) permit NV0000060.

2.2 Geology

This section describes the geology present at the TIMET Site. Descriptions are based on published literature and site-specific lithologic data from recent and previous investigations. Two principal geologic units are formally designated within the CSM boundaries at TIMET: Quaternary Alluvium and Muddy Creek formation of Tertiary-age. The upper portion of Muddy Creek Formation (designated herein as the UMCf) consists predominantly of saturated, low permeability, unconsolidated to semi-consolidated silt and clay, with occasional thin, laterally discontinuous, interbeds of fine- to medium-grained sand with silt and gravels to a depth of approximately 275 feet bgs.

The UMCf has been further divided into local stratigraphic units to facilitate discussion of site characteristics and hydrogeology by other investigators in the BMI complex. With these

informal Muddy Creek formation units added, the sequence (from youngest to oldest) at TIMET includes:

- Quaternary Alluvium (Qal)
- Transitional Muddy Creek Formation (xMCf)
- Upper Muddy Creek Formation (UMCf)
 - Fine-Grained UMCf (fMCf)
 - Coarse-Grained UMCf (cMCf)

Investigations conducted by TIMET have been limited to the Qal and UMCf.

2.2.1 Quaternary Alluvium

The TIMET Site is located near the south margin of Las Vegas Valley on Quaternary-age alluvial fan deposits of the McCullough Range (Figure 1-1). The surface of the Qal, which is the present-day land surface at most of the BMI Complex and throughout much of the Henderson area, slopes north toward the Las Vegas Wash. In the vicinity of TIMET, the slope is approximately 2.7 percent. Closer to the Wash, the slope is about 1.5 percent.

The thickness of the Qal ranges from a feather edge at the mountain front, about 1 mile south of the Site, to about 80 feet near the Las Vegas Wash, about 2 miles to the north. Within the study area, the thickness of the Qal ranges from approximately 40 to 80 feet. The unit is thickest where it was deposited in paleochannels eroded into the surface of underlying finer-grained sediments.

The Qal is predominantly sands and gravels that consist mainly of volcanic detritus (Carlsen, Lunnis, and Prudie 1991). Several hundred borings and monitoring wells have been drilled into the unit at the BMI Complex, and lithologic descriptions show that the unit is typically logged as silty or sandy gravel, sand, or silty sand (Desert Research Institute [DRI] 2004). Common Unified Soil Classification System (USCS) 2 soil groups are GP, GM, SW, SP, and SM.

The Qal deposits have been deposited unconformably on an erosional surface present that forms the top of the older, northward sloping MCf. The Qal deposits are locally cemented with caliche, predominantly near the contact with the underlying MCf.

2.2.2 Muddy Creek Formation

The Qal is underlain by the MCf, an older valley-fill unit of Tertiary age (Bell and Smith 1980). During drilling, the contact between the two units is usually easy to recognize based on color, grain size, and drilling characteristics. There are no known surface exposures of the Muddy Creek Formation at the BMI Complex.

According to the Nevada Bureau of Mines and Geology (1988), the Muddy Creek Formation consists of basin fill sediments of lacustrine and subaerial origin (Bingler 1977). These sediments are several million years older than the overlying Quaternary Alluvium, and the contact between the two units is an erosional unconformity. The top of the MCf slopes toward Las Vegas Wash, approximately parallel to the slope of the land surface.

The source of Muddy Creek sediments has not been completely resolved. Some of the sediments have a local origin, but a portion appears to have been deposited in pre-Grand Canyon time by the proto-Colorado River. The MCf occurs in more than a dozen closed basins at the eastern edge of the Basin and Range physiographic province in northwestern Arizona, southwestern Utah, and southern Nevada. To the east, closer to a suspected sediment source, the MCf is mostly sand. In the westernmost basins (which include Las Vegas Valley), silt and clay predominate in thick, tabular beds (Schmidt 2000).

In the vicinity of the TIMET Facility, the total thickness of the MCf is unknown. Existing TIMET wells extend no more than 100 feet below the upper contact. Deeper wells were drilled for groundwater investigations at the Former Pepcon Facility, Montrose, Stauffer/Pioneer, and Tronox (formerly Kerr-McGee) (Kleinfelder 1999; SECOR 2002; Kerr-McGee 1999). More recently, BRC drilled several Muddy Creek wells in the Upper and Lower Ponds area east of Pabco Road (BRC 2004).

However, the Muddy Creek Formation also extends below the deepest of these wells. According to ERM (2003), 2,158 feet of Muddy Creek sediments were drilled at a salt exploration well about 2 miles north of the former Stauffer Plant Site.

The UMCf consists of clays and silts with lesser and varying amounts of fine-grained sand. Investigations conducted by TIMET and others in the BMI Complex have identified the presence of a reworked or “transition zone” of fine-grained sediments underlying the base of the Qal deposits at some locations. These fine-grained sediments are interpreted as reworked materials (primarily clays and silts) from the underlying finer-grained UMCf that have been redeposited with coarser-grained sediments and caliche at the base of the Qal. Sediments are derived in large part from the UMCf and therefore appear visually similar to UMCf. However, the xMCf consists of reworked, less consolidated and indurated sediments with a greater proportion of coarse grained materials compared to the underlying sediments of the UMCf.

At the TIMET Facility, the xMCf has been logged as SM (silt and sand mixture) and the underlying UMCf has generally been logged as a silty clay or clayey silt. Sand layers have been observed in the UMCf at other locations in the BMI complex. At the Montrose and Tronox sites, UMCf is predominantly fine-grained; however, interbedded sand layers with thicknesses of 1 to 13 feet were observed in the fine-grained strata (SECOR 2002; Kerr-McGee 1999).

The proportion of coarse-grained sediments in the UMCf appears to decrease to the east and north. At most wells and borings drilled by BRC in the Upper and Lower Ponds area (BRC 2004), sand lenses were rarely observed in the UMCf.

Figure 2-1 depicts the cross section of local stratigraphic and topographic relationships where the xMCf occurs at the northern Plant Site.

2.3 Groundwater Hydrology

Groundwater occurs beneath the Plant Site in the Qal, the xMCf, and in the UMCf. At the TIMET Facility, groundwater in the Qal and xMCf is referred to as the First Water-Bearing Zone (First WBZ).

2.3.1 Hydraulic Conductivity

2.3.1.1 First Water-Bearing Zone

A number of hydraulic stress (pumping tests and single well recovery, or “slug” tests) were conducted during 2006 in order to estimate hydraulic conductivity at the Site. The methodology and interpretive results are included in Attachment 1. Hydraulic conductivity values, estimated based on tests using monitoring wells screened at least partially in the Qal, range from a low of about 0.07 ft/day to a high of 125 ft/day (Table 2-1). The value of 0.07 ft/day was from a slug test performed in TMMW-102, located on the south Site boundary along Lake Mead Boulevard. This well is screened across both Qal and xMCf. However, at the time of the withdrawal test the saturated thickness of the Qal was approximately 1 foot and the hydraulic conductivity obtained is more representative of upper, reworked xMCf sediments. The other wells tested along the south boundary of the site (TMMW-1, TMMW-3 and TMMW-4) also yielded comparatively low hydraulic conductivity estimates from withdrawal tests (2 ft/day, 1.4 ft/day and 1.3 ft/day, respectively). These results suggest the saturated Qal on the south side of the site contains greater proportion of fines relative to the saturated Qal toward the north portion of the Site.

The geometric mean of all hydraulic conductivity values obtained for wells screened in the Qal is 7.8 ft/day. If the data from TMMW-101 through TMMW-104 (located on the south property boundary), are separated from the northern Plant Site, the northern Plant Site geometric mean is 35 ft/day. The geometric mean of the 4 results on the south plant boundary (TMMW-101 through TMMW-104) is 0.7 ft/day.

During 2007-2008, a series of continuous multi-chamber tubing (CMT) wells (27 monitoring wells at 5 locations) were installed and tested to assess the vertical profile (geology, hydraulic properties and chemistry) at the Site. CMT well locations are discussed in Section 6.2.6 (see Figure 6-101). Results of this vertical delineation study are presented in the report titled “Tasks I, II, and III Data Transmittal Report in Support of the Groundwater Remedial Alternatives Study” (TIMET, May 16, 2008). The hydraulic analysis from this report is included in

Attachment 2. During this investigation, slug tests were conducted in the xMCf horizon at 8 locations. Estimated hydraulic conductivity values from these tests ranged from 2.4×10^{-3} ft/day to 2.8×10^{-1} ft/day (Table 2-2). The geometric mean hydraulic conductivity value for the xMCf is 4.5×10^{-2} ft/day.

This indicates the Qal (excluding the southern boundary of the Site) is characterized by hydraulic conductivity approximately 800 times greater than the xMCf. Therefore, while grouping the Qal and xMCf into the First WBZ may be appropriate in the sense that there is no substantial confining layer separating these two units (though slightly upward gradients have been measured), they are geologically and hydraulically dissimilar.

2.3.1.2 Deeper Zones

The MCf below the xMCf has been investigated through installation, testing and sampling of the CMT wells as mentioned above. Deeper water bearing zones occur in coarse grained MCf facies and are confined by fine grained MCf facies. Coarser grained MCf strata were encountered and tested at 7 locations. Hydraulic conductivity estimates from single well withdrawal tests (See Table 2-2) ranged from 9.6×10^{-3} ft/day to 5.7×10^{-2} ft/day.

The hydraulic conductivity of fine grained facies in the MCF is estimated to be on the order of 10^{-3} ft/day based on results of slug tests (TIMET, 2008). Laboratory testing of field identified fine grained samples yielded vertical hydraulic conductivity estimates on the order of 10^{-4} to 10^{-5} ft/day. The indicated ratio of vertical to horizontal hydraulic conductivity is 0.1 to 0.01.

2.3.2 Hydraulic Gradient

The First WBZ is unconfined. The water table slopes northward at a horizontal hydraulic gradient of approximately 0.02 (Figures 2-2 and 2-3), roughly paralleling the surface topography.

At the TIMET Facility, the water table occurs in the lower portion of the Qal. The entire geologic sequence explored beneath the Site appears to be saturated: the Qal, the xMCf, and UMCf. Moreover, the hydraulic gradient over the course of the sequence is generally up, with larger upward gradients measured between the well screens set in the MCf and the well screens set in the Qal/xMCf.

Table 2-3 presents hydraulic head measurements from 27 CMT wells installed in transitional xMCf and MCf. All CMT chambers installed below the water table charged with groundwater, recovered after development, and achieved static heads suggestive of a continuum of saturation.

The hydraulic heads in the xMCf are similar to those in the Qal. The heads in the MCf are typically greater (with the exception CMT-106 to -107), and indicate confined conditions.

2.3.3 Groundwater Flow

2.3.3.1 Prior to Implementation of Groundwater Remediation

As described in Section 5.0, TIMET has implemented a groundwater remediation program consisting of a barrier wall along the northern site perimeter and a line of extraction wells along the upgradient side of the wall. The system became operational on March 12, 2014. Prior to construction of the barrier wall and groundwater extraction system, groundwater flow in the saturated Qal occurred northerly from the property toward the regional groundwater discharge zone along the Las Vegas Wash.

The direction of groundwater flow within the First WBZ appears to be influenced by the slope and erosional features of the upper surface of the UMCf. The surface of the Muddy Creek Formation slopes predominantly to the north at a gradient of approximately 0.01 to 0.03. Erosional features, or paleochannels, have been identified on the surface of the Muddy Creek Formation throughout the BMI Complex (Geosyntec, 2007). The paleochannels are typically narrow and elongated and locally influence the direction of groundwater movement in the First WBZ between the TIMET site and the Las Vegas Wash.

As part of a groundwater modeling effort to support the design of the groundwater extraction system, TIMET developed a water balance which evaluated inflows and outflows to and from the Qal and xMCf within the confines of the site. This evaluation is described in detail in the Tasks I, II, and III Data Transmittal Report (TIMET 2008a).

The water balance evaluated the following:

1. Groundwater inflow through Qal and transitional MCF along Lake Mead Drive.
2. Upward seepage from the MCF into the transitional MCF over the former TRECO and TIMET Site area estimated at 9.4 million square feet.
3. Infiltration estimated at 1% of precipitation over 85% of an unpaved/unlined area within the defined area of 9.4 million square feet, or 8 million square feet.
4. Outflow via groundwater seepage through the north boundary in Qal and transitional MCF.

Based on the water budget, TIMET concluded (Table 2-4):

1. The horizontal outflow through the Qal across the northern TIMET site boundary is estimated to be 5978 ft³/day (31 gpm).
2. The horizontal outflow through xMCf across the northern TIMET site boundary is estimated to be 109 ft³/day (0.57 gpm), less than 1/50th of the outflow in the Qal.

3. The horizontal groundwater inflow through the Qal to the site along the upgradient perimeter (as estimated along Lake Mead Drive) is 1871 ft³/day (9.7 gpm).
4. The horizontal groundwater inflow through the xMCf to the site along the upgradient perimeter is estimated to be 130 ft³/day (0.68 gpm), about 1/14th that estimated for the Qal.
5. Inflow to the Qal through precipitation infiltration is estimated to be 92 ft³/day (0.48 gpm).
6. The difference between the horizontal and infiltration inflow and horizontal outflow estimated for the Qal was concluded to be primarily attributable to upward groundwater flow from the UMCf to the Qal across the 8,400,000 ft² of UMCf/Qal contact area beneath the TIMET site. The upward seepage from the UMCf to the Qal was estimated to be 2820 ft³/day (15 gpm).

2.3.3.2 Hydraulic Impact of the Groundwater Remediation System

As described in Section 5.5, in March 2014 TIMET completed construction of a vertical barrier wall along the north (downgradient) perimeter of the site and installation of a line of 19 groundwater extraction wells along the south alignment of the barrier wall. Since the Groundwater Treatment System (GWTS) was brought on-line March 12, 2014, the system has created a physical and hydraulic barrier to off-site flow, effectively capturing and treating groundwater that formerly would have migrated off-site.

TIMET is currently collecting data to evaluate the effectiveness of the barrier in preventing off-site flow. A performance assessment based on preliminary data is presented in Section 8.0.

3. Historical Information

3.1 Operational History

Prior to 1941, the TIMET Plant Site and surrounding area was undeveloped desert. In response to the outbreak of World War II, the United States military established a substantial aircraft-purchasing program. Because magnesium metal was a crucial component in aircraft production, the United States government took action to ensure the supply of magnesium by deeding 5,000 acres in the southeast quadrant of the Las Vegas Valley for the manufacture of magnesium metal. The operational history post-1941 is summarized below.

3.1.1 United States Government

On August 1, 1941, the United States government entered into an agreement with Basic Magnesium, Inc. for the construction of magnesium facilities, which were designated Plancor 201 (BRC 2006). The plant began operations in August 1942 and went into full production in July 1943. With the war coming to an end and the magnesium supply increasing, the demand for magnesium declined, thus ending the operation of the magnesium plant in November 1944.

The government's agreement with Basic Magnesium, Inc. for the operation of the plant was terminated when J.M. Montgomery & Co., Inc. took over supervision of the facilities in May 1945 (BRC 2006). In 1949, the magnesium plant was transferred to the Colorado River Commission (CRC) by the War Assets Administration; and in 1951, Basic Management, Inc. was formed to administer the property. Over the next several years, portions of the facilities were leased to various private industry companies. This began the gradual conversion of the magnesium plant into a private-sector manufacturing complex, currently referred to as the BMI Complex. A recounting of the transactions was developed and reported in Section 2.0 of the BMI Common Areas Closure Plan, dated August 2006 (BRC 2006).

3.1.2 Titanium Metals

In 1950, TIMET was formed by a joint venture agreement between Allegheny Ludlum Steel Corporation and National Lead Company to manufacture titanium metal. As part of its payment to the federal government, the CRC reassigned six leases to the General Services Administration (GSA) in January 1953 (BRC 2006). It was from the GSA that National Lead Company purchased the manufacturing facilities and property now encompassing the TIMET Plant Site.

3.1.2.1 Lessees and Easements on Plant Site

Over the operational period of TIMET continuing to present, various buildings and parcels of land were leased to industrial or commercial companies. Other portions of land were also

transferred via easement to utility providers. Information on the tenants and easements granted has been compiled from the BMI Common Areas, BRC Closure Plan (BRC 2006), and the previous TIMET Environmental Site Assessments (ESA) reports referenced. Table 3-1 lists the various companies, areas occupied, and their associated operations. Though not listed on Table 3, U.S. Vanadium (a subsidiary of Union Carbon and Carbide Corporation) may have leased areas of the property in the 1940s. The use of the Site by U.S. Vanadium has not been determined by TIMET.

3.1.2.2 TIMET Activities

The principal products manufactured by TIMET are titanium ingots, titanium tetrachloride, titanium sponge, and titanium fines. The titanium manufacturing processes, including process flow diagrams and major modifications that have occurred over time, are summarized in Section 4.0. The manufacturing process results in the generation of both solid and liquid waste streams that were managed and disposed of on and off site. Facility waste streams and on-site management practices and facilities are described in Section 4.0.

Historically, TIMET operated the Pabco Road Ponds, were located on the northeast side of Boulder Highway, approximately 2,000 feet north-northeast of the Plant Site. The Pabco Road Ponds were originally part of the former wastewater effluent ponds and conveyance ditches (Alpha and Beta Ditches) into which various wastewaters from the BMI Complex were discharged from the early 1940s through 1976. From the 1940s to the mid-1970s, the unlined Upper and Lower Ponds were used as evaporation and infiltration ponds for process effluent from the BMI Complex. TIMET built 31 lined ponds on top of the southwestern portion of the Upper Ponds from 1976 to 1982. The ponds received four waste streams generated as process effluent from the facility. The waste streams included effluent from the continuous sludge dryer (CSD), leach liquor, other process waters (OPW), and spent caustic. This process effluent was piped to permitted ponds in the Pabco Road Ponds Area for neutralization and evaporation. As part of the Liability Transfer and Assumption Agreement between TIMET and BRC, BRC assumed responsibility for characterizing and remediating the contents of the active ponds in the Pabco Road Ponds Area and any residual soil contamination and resultant groundwater impacts. In order for BRC to effectively characterize and remediate contaminants in the Pabco Road Ponds Area, TIMET had to eliminate the discharge of their process effluent to the Pabco Road Ponds. As a result, TIMET elected to construct a Wastewater Conservation Facility (WCF) on the Plant Site. The purpose of the WCF was to treat process effluent on site and, in doing so, discontinue the use of the ponds in the Pabco Road Ponds Area. Following construction and start-up of the WCF in 2005, TIMET sold this property to the Landwell Company.

3.2 Regulatory and Investigation History

In 1991, NDEP entered into Consent Agreements with six of the companies located within the BMI Complex in Henderson, Nevada. Present and former owners and operators entering into this agreement included TIMET; Chemstar Corporation; Kerr-McGee Chemical Corporation

(Kerr-McGee); Montrose Chemical Corporation of California, Inc. (Montrose); Pioneer Chlor Alkali Company, Inc. (Pioneer); and Stauffer Management Company, Inc. (Stauffer). The following three phases were identified in the Consent Agreement:

Phase I – Develop Phase I Environmental Conditions Assessment (ECA) reports for the BMI Common Area, which consists of the Upper and Lower Ponds, conveyance ditches and the Pabco Road Ponds Area, and each individual company site

Phase II – Perform an Environmental Conditions Investigation (ECI) to fill data gaps identified in Phase I, if determined necessary by NDEP

Phase III – Identify and implement appropriate remedial measures to address conditions identified in Phases I and II, if determined necessary by NDEP

TIMET completed a Phase I ECA, and results of the ECA were presented in the “Final Report of Phase I Environmental Conditions Assessment” (Law Engineering, Inc. 1993). Based on the information in the TIMET Phase I ECA and subsequent discussions with TIMET, NDEP issued a letter of understanding (LOU), dated August 16, 1994, that identified 54 study items where additional information or further investigation was recommended. On June 7, 1996, TIMET submitted a response to the LOU, including identifying LOU items requiring additional investigation. In June 1996, NDEP entered into a Consent Agreement with TIMET to perform an ECI, remedial alternative studies, interim remedial measures, and additional work.

The action items identified in the LOU response were addressed in the Phase II ECI in accordance with the June 1996 Consent Agreement. Results of the ECI were reported in the “Final Environmental Conditions Investigation Report” (Tetra Tech 1998) and the “Environmental Conditions Investigation Addendum Draft Report” (Tetra Tech 1999).

The results of these investigations and additional assessments of potential source areas (PSAs) were compiled and interpreted in the “Conceptual Site Model” (TIMET 2007b). This report was disapproved by NDEP which presented (by letter dated June 6, 2007) comments and requests for additional data. Subsequent to submittal of the 2007 CSM Report, TIMET conducted a series of investigations in support of development of the groundwater remediation program at the Site. These investigations are presented in the following reports which have been submitted to and approved by NDEP:

- “Tasks I, II, and III Data Transmittal Report In Support of the Groundwater Remedial Alternative Study, TIMET, Henderson, Nevada.” May 16, 2008.
- “Remedial Alternatives Study First Water Bearing Zone, TIMET, Henderson, Nevada.” September 15, 2008.

These reports were the basis for the Record of Decision for Remediation of Groundwater in the First Water-Bearing Zone (NDEP, February 17, 2009) (ROD).

4. Site Operations

This Section presents an overview of TIMET operations including manufacturing processes, raw material use, waste streams, and waste management. This information was used to identify chemicals which may have been released to soil or groundwater at the facility (site related chemicals or SRCs), and PSAs associated with chemical releases or disposal.

The process and waste stream information summarized in this section was obtained from a review of facility processes, previous site investigations, assessments including waste analyses, the Phase I ECA (Law Engineering, Inc. 1993), the ECI and ECIA (Tetra Tech 1998, 1999). Identification of SRCs is documented in the "Site-Related Chemicals Technical Memorandum," dated October 13, 2004 (Tetra Tech 2004a). Identification of PSAs is documented in the "Potential Source Areas Technical Memorandum," dated July 5, 2005 (Tetra Tech 2005b).

4.1 Manufacturing Processes

Processes conducted on what is now the TIMET Site have included production of magnesium ingot, as well as titanium tetrachloride, titanium sponge, and titanium ingot. Magnesium production was conducted by Basic Magnesium, Inc. for the U.S. Government during the years 1942 through 1944. Titanium production operations have been conducted on the site from 1951 until present.

Tenants with process operations on the TIMET Site have included Pioche Manganese and Chemtec (Law Engineering, Inc. 1993). Pioche Manganese was a tenant on the TIMET property from 1951 through 1956. Chemtec Corporation was a tenant for an undetermined period of time from 1972 until 1978.

4.1.1 *Historic Processes Prior to TIMET: Magnesium Production*

Magnesium production operations included a chlorine/caustic plant, which was located off-site to the west of the TIMET property, and the magnesium production facilities, some of which were located on what is now the TIMET Plant Site (BRC 2006).

The magnesium plant consisted of 10 buildings, Units 1 through 10. Units 7, 8, 9, and 10 are located on the TIMET Plant Site. Units 8, 9, 10 and a portion of Unit 7 are still used by TIMET. Each of the magnesium plant buildings were divided into two rooms: a chlorinator room and an electrolytic cell room. The chlorinators produced the feed for the electrolytic cells by converting magnesium into magnesium chloride. In this process, magnesium oxide was mixed with coke,

recycled magnesium chloride, and peat moss to form a pellet. The pellets were dried and fed to the chlorinator. The material was heated to the appropriate temperature which formed molten magnesium chloride which was then drawn off and transported to the electrolytic cells.

Electrolytic cells contained a molten salt bath consisting of the chloride salts of sodium, potassium, calcium, and magnesium. The cells consisted of steel cathodes and graphite anodes contained in a refractory-lined steel box. When a direct current passed through the cell, chlorine gas was drawn to the positively charged anode, and magnesium was drawn to the negatively charged cathode of the cell. The magnesium eventually broke off of the cathode and floated to the top of the cell. Periodically, the magnesium was removed from the cell and then cast into ingots or mixed with other metals to make magnesium alloys.

Waste streams from the magnesium plant operations likely included solid and liquid wastes similar to the wastes generated by TIMET. Waste streams from the magnesium operations were discharged to the on-site J-9 Tailings Ponds, the S-18 Landfill, and off site to the BMI Tailings Ponds.

4.1.2 Former Tenant Processes

4.1.2.1 Pioche Manganese

Pioche Manganese conducted operations in Building J2 and owned Unit 10. Pioche Manganese processed ore from the nearby Three Kids Mine using an arc (carbon electrode) furnace for approximately 4 years (1954 through 1958). The ore melting operations in Building J2 produced manganese and process slag (the major waste stream), which was stockpiled east and north of Building J2. Pioche Manganese wastes were placed in the S-18/J2 Landfill and the manganese slag was stockpiled in the area referred to as the S-20 Landfill. The J2 Landfill was purchased by TIMET in 1979 from Pioche Manganese (Law Engineering, Inc. 1993, Section 3.1.2).

4.1.2.2 Chemtec

Chemtec leased Building K-55 for use as a laboratory from TIMET from about 1975 until March 1978. The facility may have included a small pilot plant. Laboratory wastes discharged to the OPW waste system included about 2 gallons per week of acids (hydrochloric, nitric and sulfuric), sodium salts, and small quantities of reagents (source).

4.1.3 Titanium Production

Titanium production has occurred in Units 7 through 11 on the Plant Site (Figure 1-3). The major titanium production processes include:

- Chlorination
- Purification

- Reduction
- Magnesium recovery
- Leaching
- Crushing
- Blending/melting
- Scrap reclaim
- Laboratory testing

Process flow diagrams for operations from the 1950s through 1993 (Figure 4-1), 1993 through 2005 (Figure 4-2), and 2005 through present (Figure 4-3) show the titanium production processes and identify building locations, raw materials, intermediates, waste streams, and waste stream disposition and relative volumes. The volumes shown on the process flow diagrams are not exact quantities and have varied over time because of production rates and process changes. The volumes are presented to provide an indicator of the volume of wastes coming from each production unit. Air emissions from the facility have been controlled and are permitted by the Clark County Department of Air Quality and Environmental Management (DAQEM). Fugitive dust emissions and the potential impact on site soils are considered in the CSM).

4.1.3.1 Chlorination

Rutile ore contains (>95%) titanium dioxide (TiO_2). In chlorination, TiO_2 in the rutile is reacted with chlorine to produce titanium tetrachloride (TiCl_4). Chlorination takes place in the north portion of Unit 8. The chlorination unit includes chlorinators, condensers, caustic tanks, caustic towers, wash towers, and venturi scrubbers. In the chlorinators, chlorine gas is passed through a mixture of rutile ore and coke at 1,000 °C to produce crude TiCl_4 . The crude TiCl_4 is collected in the off-gas from the chlorinator along with other chloride gases and is liquefied by passing the gas through a series of condensers. Residual TiCl_4 is removed from the off-gas from the final condenser in a wash tower. Residual acids and chlorine are scrubbed from the off-gas in a caustic tower. Particulates are removed with venturi scrubbers prior to venting.

Acid wastes and caustic wastes from the wash towers are discharged to the OPW and caustic wastewater systems. The primary solid wastes, chlorinator dust and chlorinator bed dump, are nonhazardous and have historically been disposed in the J2 Landfill. Chlorinator dust is currently transported off site for disposal. There have been no major changes to chlorination raw materials or processes from the 1950s to the present.

4.1.3.2 Purification

In purification, the crude TiCl_4 is mixed with a nonhazardous proprietary chemical to complex and remove trace metal impurities. Purification includes fractionation columns, condensers, storage and vaporization tanks, and a vent condenser and scrubber system. The treated TiCl_4 is vaporized in a vaporizer tank and then distilled to remove low- and high-boiling chloride impurities. A recycle stream of liquid TiCl_4 containing approximately 25 percent solids is diverted from the vaporizer tank to the CSD. In the CSD, the TiCl_4 is vaporized, condensed, and recycled to the crude feed tanks. The CSD solids are sluiced with OPW liquids for on-site management. Scrubber wastewater is discharged to the OPW system. There have been no major changes to purification raw materials or processes from the 1950s to the present.

4.1.3.3 Reduction

1951-1993 (Old Process):

The old reduction process involved the reduction of TiCl_4 with magnesium metal to produce titanium and magnesium chloride in the J-1 and J-5 buildings. The reduction reactors were loaded with magnesium and heated to 850 °C to melt the magnesium. TiCl_4 was then injected into the reactor where it reacted with the molten magnesium to form molten magnesium chloride salt and titanium. The molten magnesium chloride was tapped off the base of the reactor and sent to the magnesium recovery unit. The reactor was cooled with non-contact cooling water (NCCW) and the titanium was removed.

Venturi scrubber water and NCCW used on the reactors and a vacuum pump were discharged to the Alpha Ditch. Solid wastes generated during the process (titanium, magnesium, and magnesium chloride dust) were disposed of in the J2 Landfill and BMI Landfill (located off-site to the west).

1994-Present (Vacuum Distillation Process):

A vacuum distillation process is currently used for reduction. The current reduction process occurs in Unit 10. The chemical reactions are the same as the old process. Magnesium is reacted with TiCl_4 to form molten magnesium chloride salt and titanium. After the reaction, the magnesium and magnesium chloride salts are distilled from the titanium mass in the Vacuum Distillation Process (VDP). The VDP vessel is then cooled and the titanium is removed. The magnesium chloride is recycled to magnesium recovery for reuse. Solid wastes include titanium, magnesium, and magnesium chloride dusts. These wastes were disposed of in the J2 Landfill.

Liquid wastes include cooling tower blowdown, VDP scrubber water, the sand filter backwash, the VDP reverse osmosis unit cleaning water, the spray return tank discharge, and various floor drains. All of these liquid wastes were routed to the OPW system until 2005. Beginning in 2005, the OPW wastes were routed to the WCF.

4.1.3.4 Magnesium Recovery

Prior to 1983, magnesium recovery was conducted in Units 7 and 10. In 1983, new, more efficient magnesium recovery cells were installed in Unit 9 to replace the older cells in Unit 10. During magnesium recovery, the molten magnesium chloride from reduction is electrolytically converted to magnesium metal and chlorine gas. The magnesium metal is recycled to reduction and the chlorine gas is recycled to chlorination.

Solid wastes include electrolytic salts, smut, refractory brick, and carbon anodes that were disposed of in the J2 Landfill or sold for recycling. Liquid wastes include spent caustic, cooling tower blowdown water, anode cooling water system reject water, chlorine compressor area washdown water, and baghouse salt solutions. The liquid wastes were discharged to the spent caustic or OPW systems until 2005. After 2005, the liquid wastes were discharged to the WCF.

The magnesium recovery operations have been identified as producing low levels (less than 50 mg/kg) of polychlorinated biphenyl (PCB) compounds as a byproduct. This inadvertent generation of PCBs in the magnesium recovery process is discussed separately in Section 4.3.

4.1.3.5 Leaching

The leaching process, conducted in large heated tanks, removed residual magnesium and magnesium chloride salts from crushed titanium chips using a mixture of hydrochloric, nitric, and citric acids and urea (leach liquor). After leaching, the titanium chips were water rinsed and then dried. The leach liquor was neutralized with lime and discharged to on-site and off-site ponds. Water from the washer unit was discharged to the OPW system. NCCW and chip transfer water was discharged to the Alpha Ditch. Titanium fines generated from this process were sold.

The leaching process was discontinued in 1993 as it was no longer necessary once the VDP was brought on line.

4.1.3.6 Crushing

Titanium chips are processed through a multistory crusher, which reduces the size of the chip and separates it into individual size categories. Crushing is conducted in Unit 8 and Buildings J-3 and C-9. Prior to 1993, crushing was conducted before the leaching process. Since the startup of the VDP, crushing has been conducted after the distillation step.

Solid wastes from crushing have included iron, scrap metal, titanium dust, magnesium dust, and magnesium chloride dust. All solid wastes are disposed of in the J2 Landfill or sold. Liquid wastes from the crushing process include the crusher scrubber unit water from Building J-3, the C-9 wet scrubber effluent, and washdown water. All of these liquid wastes were discharged to the OPW systems until 2005. After 2005, the liquid wastes were discharged to the WCF.

4.1.3.7 Blending/Melting

The melting and blending processes are conducted in Unit 11. Blending operations combine titanium sponge into larger blends in blenders and splitters. No water or liquid is used in the blending operation. The blended titanium sponge is combined with other metal alloys, pressed into blocks using a hydraulic press, welded, and melted in consumable electrode vacuum arc furnaces.

Liquid wastes discharged to the OPW systems (until 2005; after 2005 the liquid wastes were discharged to the WCF) include washwater and pickling wastes (until the early 1980s when the pickling process was replaced with a hydroblast unit). Pickling (hydrochloric, nitric, and hydrofluoric acids) and hydroblasting were used to remove residual metal salts from titanium ingots prior to melting and blending. Solids from hydroblasting are settled out in a lugger box prior to discharge of the wastewater. Other liquid wastes that are (or were) discharged to the Blast Ditch, then to the Back Ditch, and then to the Alpha Ditch are hydroblast water, once-through NCCW, washdown water from the melt areas, water from ingot cutting, crucible cleaning water, furnace washout water, and steam ejector water discharge.

Solid wastes include titanium fines from the cyclone dust collectors that are sold. Before the 1980s, titanium fines were disposed of in the J2 and BMI Landfills. Scrap metal and sponge are recycled or sold. Solid wastes from the hydroblast unit are primarily salts that are removed from the sheath that surrounds the ingots. These salts were disposed of in the J2 Landfill. Crucible cleaning solids were also disposed of in the J2 Landfill. Since 1991, spent oil absorbents have been disposed of off-site. Prior to 1991, the spent absorbents were disposed of in the J2 Landfill. Since 1981, used oil has been collected and recycled off site. Prior to 1981, used oil was used as a dust suppressant on plant roadways.

4.1.3.8 Scrap Reclaim

Scrap reclaim is located in Unit 8. Scrap titanium delivered from various facilities is processed through a shot blast unit for cleaning and either welded into electrodes for melting or collected in reactor vessels for processing in hydrogenation furnaces. Scrap reclaim is either reused on site or sold off site.

Liquid wastes include wash water that is discharged to the spent caustic system, ingot cutting cooling water that is discharged to the OPW systems (until 2005; after 2005 the liquid wastes were discharged to the WCF), and wet cyclone water that is discharged to the Alpha Ditch.

Solid wastes include spent shot from the shot blast unit that was disposed of in the J2 Landfill and particulates from the cyclone scrubber that are collected and sold for reuse. Unit J-2 is currently used to store rutile ore and support plant wide maintenance operations. The logistics department occupies the northern portion Unit J-2 that includes a shipping and receiving dock.

4.2 Waste Streams

The waste streams from magnesium, titanium, and other (tenant-conducted) production processes are identified in process flow diagrams. Process descriptions are listed in Table 4-1. A description of each waste stream, including major waste components and known SRCs associated with each PSA, is noted. The disposition of each waste stream to on-site and off-site waste management facilities, including dates (where available) of operations, is also provided.

Characterization and identification of components of the waste streams have been made through process knowledge and waste analyses. Waste stream analytical data are provided in Attachment 3. The analytical data, while not current, do provide information concerning the chemical concentrations of the waste streams at the time of sampling. Concentrations of the waste stream constituents may vary based on process operation schedules, production volumes, and types of wastes discharges at any given time.

TIMET has prepared a Material Management Plan (TIMET and GEI, 2014) focused on solid waste and recycle materials. This Plan includes additional waste characterization, provides the procedures to ensure that the Henderson Plant maintains compliance with federal and state requirements for waste disposal. It also documents the necessary procedures, methodologies and techniques for material management including the disposition of hazardous waste, solid waste, recyclable materials and saleable product.

4.3 Inadvertent Generation of PCB Compounds

4.3.1 *PCB Background and Classification of the Excluded Manufacturing Process*

Analyses of materials generated at the facility have indicated that PCBs have been (and are) inadvertently generated in TIMET's Magnesium Recovery operation. PCBs were detected in the Magnesium Recovery operation during EPA inspections and sampling performed in 2005 and 2006. The coal tar pitch sealant used in the Magnesium Recovery headers was presumed to be the likely source of PCB generation. In 2007, TIMET completed its conversion away from the use of coal tar pitch in the electrolytic cells and PCB concentrations were significantly reduced. Cleanup of the Magnesium Recovery header system occurred in phases between 2008 and 2012 to remove PCBs. The cleaning process consisted of wet and dry cleaning of the row- and common-header pipes, removal and replacement of several sections of common-header pipe, testing and management of the pipe as scrap, and confirmation sampling of the cleaned pipe to remain in place.

Following the final phase of cleaning activities, TIMET performed PCB characterization sampling of the Magnesium Recovery system in 2013 to determine if inadvertent PCB generation persisted after removal of the coal tar pitch sealant. The sampling results showed that PCBs continue to be generated at low concentrations (i.e., below 50 mg/kg) within the

Magnesium Recovery system. The source of the PCBs is not known by TIMET. The Magnesium Recovery process involves high temperatures within the electrolytic cells, the presence of chlorides (MgCl_2) or chlorine, the use of carbon (graphite) anodes and equipment that relies on graphite carbon and organic rubber gaskets that may lead to the unintentional formation of PCBs. These characterization results were presented to the EPA in the Chlorine Header Cleaning, Replacement and Characterization Project Report, prepared in February 2014.

The PCBs are present in dust generated as a waste by-product from the Magnesium Recovery operation. The dust is present in the chlorine gas collection system piping that includes drop boxes and bag house controls for collection, removal and proper management of the dust. The dust is removed from the drop boxes using a vacuum truck with subsequent discharge into drums for off-site disposal; historically, the dust was dropped through plastic liners from the drop boxes directly into drums. Dust from the bag houses is placed directly into drums from beneath the control equipment hoppers. The dust was historically managed as a Toxic Substance Control Act (TSCA) waste pending adequate characterization of the waste stream. TIMET operates floor cleaning equipment in the Magnesium Recovery operation to cleanup potential dust residues; and historically, the floors were cleaned with wash down to collection trenches and piping to the Water Conservation Facility (WCF) and prior water management facilities. Supplemental sampling at the facility indicated that PCBs inadvertently generated in the Magnesium Recovery process appear to have historically been directed or managed at other areas of the facility, including the J-2 Landfill, HP-1 Pond and WCF. The following paragraphs summarize the characterization sampling and results from recent evaluations at the Magnesium Recovery operation, J-2 Landfill and HP-1 Pond.

4.3.2 Magnesium Recovery

Characterization sampling of the dust in the magnesium header system was performed in accordance with the “Chlorine Header Characterization Work Plan” dated April 2013, and supplemental correspondence with EPA Region 9 dated July 26, 2013 and July 31, 2013. In accordance with the work plan, dust samples were collected from selected cell hoods, row header drop boxes, and bag house particulate drums, and wipe samples were collected from floors in the Magnesium Recovery building; this sampling was performed on July 31 and August 1, 2013. All samples were analyzed for PCBs using USEPA Method 1668C, Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS. The sum of the congener concentrations was used to determine the total PCB concentration for each sample.

PCB congeners were detected in all dust samples with total (summed) PCB concentrations ranging from less than 1 mg/kg to as high as 42.2 mg/kg (Sample DB-5), with an average concentration of total PCBs in the samples of 9.2 mg/kg. The analytical results from all six floor wipe samples indicated concentrations below the 10 microgram per 100 centimeters square ($\mu\text{g}/100\text{ cm}^2$) EPA threshold for high occupancy areas. The results show that, within the

Magnesium Recovery system, inadvertent PCB generation persists at varying, but low concentrations (below 50 mg/kg).

Although PCB generation continues to occur, the sample results indicate that the concentrations are substantially lower than those present prior to cleanup of the Magnesium Recovery System. TIMET is providing documentation to EPA currently to demonstrate that the remaining PCB concentrations are the result of inadvertent generation under the “Excluded Manufacturing” definition of 40 CFR 761.1(f) and 761.3.

4.3.3 J-2 Landfill

The J-2 Landfill at the facility is a permitted Class 3 industrial solid waste landfill designed and operated to receive approved inert solid waste materials from the facility’s operational activities. There has been no known disposal of PCB wastes in the J-2 Landfill; however, an isolated area of PCB impacted material was identified within the landfill in 2008 (EPA sample TIM-11, with a concentration of 41.19 mg/kg).

On December 7, 2009, the EPA requested additional information and measures for the J-2 Landfill, and specifically that TIMET address the identified PCB impacted area. TIMET prepared and submitted a Work Plan for Preliminary Characterization of the Potential Presence of PCBs in the J-2 Landfill (“Preliminary Characterization Work Plan”) in February 2010. Based on the results of initial characterization in the area of sample TIM-11, TIMET prepared and submitted a Self-Implementing Cleanup Work Plan for PCBs in the J-2 Landfill (“Cleanup Work Plan”) dated August 2011. The self-implementing cleanup of PCBs in the area of TIM-11 was conducted in August and September of 2011. Documentation of the cleanup and results of the verification sampling showed that the area achieved the cleanup goal. These results were presented in the J-2 Landfill PCB Self-Implementing Cleanup Report (“Cleanup Report”) submitted to the EPA in February 2012 (ERM 2012).

Following this work, the EPA requested characterization of the remainder of the J-2 Landfill. A work plan for assessment of the landfill was prepared and approved by EPA and the boring, sampling and analysis program was implemented during November 2012. The associated PCB analyses showed detections of various PCB congeners, with total (sum) PCB concentrations ranging from 0.000365 to 1.27 ppm. Based on the low PCB results, i.e., a statistical UCL below the 1 ppm screening level, and EPA’s written response dated May 30, 2013, no additional characterization is required for the J-2 Landfill. Subsequent to receiving the EPA’s response on the statistical analysis dated May 30, 2013, TIMET completed closure of the J-2 Landfill in accordance with the obligations under its permit from the SNHD. No further action is planned for the J-2 Landfill.

4.3.4 HP-1 Pond

The EPA collected samples at the HP-1 Pond during October 2005, and Sample showed a PCB concentration in the pond sediment of 1.1 mg/kg, which was slightly above the Toxic Substances Control Act (TSCA) “clean soil” definition of less than 1 mg/kg (40 CFR 761.125(b)(1)(ii)). Subsequent sampling by EPA showed PCBs to be non-detectable at other locations. However, EPA requested that TIMET conduct further investigation of the sediment in the HP-1 Pond.

Site characterization sampling was conducted by TIMET in accordance with the EPA approved Work Plan for Characterization of HP-1 Pond (revised December 2010), as modified per correspondence between EPA and TIMET dated April 14, 2011 (HP-1 Characterization Work Plan). The characterization sampling occurred in July and November 2011, with additional samples collected at EPA’s request in March 2012. The resulting total PCB concentrations ranged from 0.223 to 5.22 mg/kg for the sediment samples. Half of the samples showed total PCB concentrations slightly above the TSCA “clean soil” definition of less than 1 mg/kg (40 CFR 761.125(b)(1)(ii)). However all sample results were well below the low occupancy area cleanup level of 25 part per million (ppm) for bulk PCB remediation waste (including sediment) (40 CFR 761.61(a)(4)(i) and (a)(4)(i)(B)).

The EPA requested additional measures to reduce the presence of PCBs in the HP-1 Pond. To this end, TIMET retained Clean Harbors with oversight from GEI Consulting to perform remediation of the HP-1 Pond. The sediment removal action was performed during 2013.

4.4 Site Related Chemicals

The list of SRCs was developed through evaluation of site processes, raw material and waste stream analyses, and other sources. The SRCs are chemicals in raw materials, intermediates, products, byproducts, waste components, and otherwise-used chemicals that were stored, used, produced, handled, disposed of, or otherwise used at the TIMET Site. SRCs may also include chemicals that have been detected in site media (soil, sediment, or groundwater) during previous investigations, but have an unidentified or off-site source. The list of SRCs for the TIMET facility is included in the “Technical Memorandum – Site Related Chemicals – Revision 3” included in Attachment 4. This memorandum details the methodology and rationale used in developing the list of SRCs.

The inclusion of chromium on the SRC list requires further discussion since there are two potential valence states: trivalent chromium and hexavalent chromium. Chromium is present in trace quantities in the rutile ore as trivalent chromium only (Silver State Laboratory Report, 12/11/2003 located in Attachment 3). The titanium manufacturing process concentrates trace metal quantities in process waste streams as the titanium is purified. The primary waste stream where trace metals are concentrated is the CSD solids. The chromium present in the CSD solids is also trivalent chromium (Silver State Laboratory Report, 12/18/2003 located in Attachment 3).

The former Kerr-McGee Site, bordering TIMET on the west, is a known source of hexavalent chromium which has impacted soil and groundwater at and downgradient of its facility (ENSR, 2005). The former Kerr McGee Site is now referred to as the Nevada Environmental Response Trust (NERT) Site.

4.5 Potential Source Areas

PSAs were identified on the TIMET Plant Site based on process information, waste stream management and disposition, and former site assessments and investigations. PSAs were identified in the “Potential Source Areas, Technical Memorandum,” dated July 5, 2005 (reference). The TIMET property and associated PSAs were divided into Parcels A, B, C, D, E, and F based on location, ownership, current and past use, and potential future use. Only those PSAs in Parcels A, B, C, and D which are located on the plant site or are adjacent to the plant site are included in this CSM. PSAs associated with Parcels E and F will be addressed in a separate report. The PSAs are shown on Figure 4-4 through 4-7 and detailed in Table 4-2.

Table 4-2 groups the PSAs into five source areas based on location, waste streams, and potential contaminants:

- Surface Ditches and Northern Storage Area
- Near-Surface Soil Potential Source Areas
- Pond Areas
- J2 Landfill Area
- Current and Historical Operational Areas

Subsurface piping on the site is included in the five source areas. The original LOU included an identification number for each PSA. Dates of operation, significant modifications, corrective actions, and information on closure or inactivity are provided for each PSA. A description of each PSA, including their use and waste streams managed in the PSA, is included.

4.5.1 Surface Ditches and Northern Storage Area (Source Area 1)

4.5.1.1 Northern Storage Area

The Northern Storage Area (NSA) has been designated PSA-1. It was historically used to store a variety of materials including solids from the CSD ponds and caustic pond, refractory brick, construction equipment, concrete, magnesium chloride ingots, reactor lids, asbestos containing material (ACM), and coke. The storage area is unlined and is traversed by inactive drainage ditches formerly used to convey wastewaters from TIMET and upgradient BMI facilities. The former BMI pond and siphon that are designated “BMI Common Areas” are also located in this

area. Table 4-2 contains available information concerning the historic use and potential chemical presence at the NSA.

4.5.1.2 Surface Ditches

The Beta & Northwest Ditch (PSA-11) was a “common drainage ditch” that flowed from west to east across the northern portion of the BMI Complex facilities. The ditches were active from at least 1943 until 1976 and were used to transport wastewaters and surface runoff from the BMI Complex facilities to an unlined ponds area north of the TIMET Plant.

The TIMET portion of the ditch remediation (removal action) was completed in 2013 in accordance with the Nevada Division of Environmental Protection December 14, 2012 Order (Section 5.2). Chemical presence remaining in the soils after the removal action was completed is discussed in Section 6.2.

The Mystery Ditch (PSA 11) was an open ditch approximately 1,750 feet in length. Historically, the Mystery Ditch carried process and stormwater from the south-western portion of the site along the western site boundary to the Pittman Bypass and Beta Ditch. TIMET records suggest that the Mystery Ditch may have received evaporative cooler water and floor washings from a maintenance shop in Unit 7 that was used to repair metal tote containers. In more recent years of facility operations, TIMET’s former process and stormwater discharges to the Mystery Ditch have been re-routed via pipe systems and eliminated. The open and unlined portion of the ditch has decreased in length and generally collects stormwater discharged by the neighboring Tronox property from the southern portion of the Tronox site.

4.5.2 Near-Surface Soil Potential Source Areas (Source Area 2)

The term “Near-Surface Soil PSAs” is used herein for consistency with previous TIMET environmental reports and includes areas with potential or known storage of wastes or contaminants at the surface (e.g., drum storage). This source area includes 13 PSAs:

- PSA 3 – Francy’s Mountain: This area contained approximately 8,600 cubic yards of mixed chlorinator dust and CSD solids. Francy’s Mountain has been remediated through two removal actions (See Section 5.3.1)
- PSA 9 – Low-Lying Area Adjacent to East Side of Site Pond HP-6: This low-lying area collected stormwater runoff from areas formerly used for the temporary storage of chlorinator dust and anodes.
- PSA 10 – Subsurface Piping: Current and historic piping installations used to convey stormwater, OPW, CSD, spent caustic, and leach liquor.

- PSA 12 – Alpha Ditch: The Alpha Ditch is an active unlined conveyance that traverses the eastern portion of the TIMET Plant Site and discharges non-contact cooling water. In addition to non-contact cooling water, past wastewater discharges may have included venturi scrubber water, dewatering box water, swamp cooler water, and hydroblast descaling water. Approximately 6.4 mgd are currently discharged to the Alpha Ditch, which is approximately 260 feet long.
- PSA 17 – S-17 Landfill: The S-17 Landfill is an area identified as a landfill and contains mounded dirt and a bermed area. It is believed to be an area where wooden pallets were stored and destroyed (possibly burned). If burning occurred at the area, polyaromatic hydrocarbons (PAHs) may have been released.
- PSA 21 – Back Ditch: The Back Ditch has been in use since the early years of facility operations. The Back Ditch is estimated to have extended approximately 1,000 feet in length including an extension from the Melt Shop Blast Ditch to the Alpha Ditch. It is reported that the Back Ditch also received waters from a drum crusher unit circa 1984. Up to at least the early 1990s, the physical and chemical characteristics of waters discharged to the Back Ditch were not monitored until after mixing with waters discharged to the Alpha Ditch, but the water would be expected to have characteristics similar to the Alpha Ditch based on the operations. Visual inspections in 1991 indicated liquids were discharged from the lower floor of the Melt Shop to the Blast Area and on to the Back Ditch.
- PSA 22 – Boneyard: The Boneyard is an area where discarded transformers and other electrical equipment were historically stored.
- PSA 23 – Soils in Area South of Building K-53 Bay Doors: Building K-53 is a miniature melt shop, a machine shop, and a mechanical testing laboratory. When there was a crucible jacket failure, residual NaK (a heat transfer fluid) was historically cleaned outside Building K-53. This occurred approximately twice a year. Prior to cleaning outside, the NaK was drained from the crucible jacket into an indoor reservoir. The crucible jacket was then purged with dry steam outside the building to remove any residual liquid (approximately 8 fluid ounces). The NaK from the jacket reacted with the cleaning water to form sodium and potassium hydroxides, which were allowed to infiltrate into the soil. Crucible jacket cleaning operations have not been conducted in this area since the mid-1980s.
- PSA 25 – Chemtec Corporation Site: Chemtec leased Building K-55 for a period of about 3 years. Operations are believed to be a laboratory and possibly a pilot plant. Industrial wastewater containing acids was discharged to the OPW system. Components of the wastewater included approximately 2 gallons per week of acids (hydrochloric acid, nitric acid, and sulfuric acid), sodium salts, and small quantities of standard laboratory

reagents. Tailings were stored outside the building. No evidence of Chemtec operations remain at Building K-55.

- PSA 28/29 – Hydroblast Descaling Water Channel/Unit 11 Liquid Discharge Channel: Liquids conveyed from the melt shop include hydroblast descaling water, non-contact cooling water, wash-down water, crucible cleaning water, furnace washout water, and steam ejector water; these waters are discharged to the concrete-lined Blast Ditch. Prior to discharge to the Blast Ditch, hydroblast descaling water is directed through a sedimentation chamber to separate solids. A report detailing sampling and analysis in this channel was submitted to NDEP (Hydro-Search, 1996).
- PSA 32 – White Material Deposits: This operating area is an abrasive blast area where various equipment parts are cleaned. Hydro-Search (1996) reports that the white material deposits are believed to be magnesium oxide cleaned from equipment or silica sand used for abrasive blast. The area is paved with asphalt, and the white material deposits are routinely removed and were disposed of in the J-2 Landfill
- PSA 34 – Spill Stain on Avenue F: The spill stain referenced in the ECA is believed to be in areas where magnesium chloride solution was sprayed for dust control in the past.
- PSA 35 – Drum Storage Areas: The drums in the drum storage areas were inventoried during the ECI and found to contain scrap metals, rubber hoses, in-process materials, alloys for use in the melt shop, recycleable metals, and some roofing tar material (that were disposed of off-site). There were no apparent leaks in any of the drums.

In addition to the above-listed PSAs, other miscellaneous PSAs are grouped as part of the near-surface sources. The miscellaneous (minor, localized) PSAs are not necessarily attributed to specific historic operations and include the following:

- PSA 18 – Area of Stained Soil Between Units 8 and 9: TIMET believes that the darkened areas on the 13th Street roadway visible on certain aerial photographs are from rubber tire marks because the darkened area does not extend from the roadway to the purification process area and no darkened or stained areas were observed in the aerial photographs in the purification process area.
- PSA 19 – Vicinity of Northwest Corner of Unit 7: This is an area where solvents from the paint shop may have been released.
- PSA 20 – Unit 10 Demolition Soil Stockpile: During the demolition of Unit 10, about 70 tons of potentially hydrocarbon-contaminated soils were destroyed by Las Vegas Paving. Documentation of the destruction and the Clark County Health District closure letter indicating no further remediation is required was submitted to NDEP (Hydro-Search, 1996)

- PSA 31 – Perimeter and Interior Roadways: Solvents blended with waste oil were disposed of on the roadways for dust control. The ECA reports that prior to 1981 waste oil was used as a dust suppressant on roadways. Sampling and analysis was conducted and reported during the ECI (Tetra Tech, 1998).
- PSA 36 – Rail Delivery Areas and Acid Tank Farm and Ancillary Piping: Unlined rail delivery areas historically received acidic solution products for leaching. Four ASTs containing hydrochloric acid and three ASTs containing nitric acid were located within the acid tank farm. Each tank had a capacity of approximately 25,000 gallons. The tanks were located on neutralizing limestone rock over soil. The acid tank farm was bermed and runoff from the acid tank farm was directed to the OPW drain system. In November 1985, an ancillary piping failure occurred in the main HCl feed line outside of Unit 8. The volume of HCl released is unknown. In December 1988, a second ancillary piping failure occurred and approximately 1,500 to 2,000 gallons of nitric acid leaked from the main supply line from the acid tank farm. As a result of the failure, the HCl supply line also failed and approximately 400 to 500 gallons of HCl was released to subsurface soils. Leaching acids are no longer used at the TIMET facility. The tanks have been filled with water and remain in place.
- PSA 37 – Coke Storage Silo: Fine-grained coke is unloaded from railcars into a silo located in a three-sided building. Coke is loaded into lugger boxes for transport by forklift to chlorination (Unit 8).
- PSA 38 – Titanium Tetrachloride Railcar Loading: Liquid titanium tetrachloride is loaded from five storage areas into railcars for shipment. Drip pans along the railroad are used to capture drips or spills.

4.5.3 Pond Areas (Source Area 3)

This source area includes seven PSAs and their associated waste streams, including:

- PSA 2 – CSD North and South Ponds: Settling ponds that received CSD solids slurried with OPW effluent. The ponds were unlined until 1976. The contents of the CSD North and South Ponds were removed and disposed of off-site. The ponds were excavated to a depth of 10 feet.
- PSA 5 – Site Pond SW-1: The SW-1 pond is an inactive PVC double-lined pond constructed in 1976 over the area referred to as the former unlined North Nitrate Pond. The SW-1 pond received leach liquor from 1976 until 1984. From 1984 until 1990, the pond was used as a settling/overflow pond for the OPW liquid wastes. The current condition of the liners is not known. SW-1 is currently filled with CSD solids.

- PSA 6 – Site Pond HP-1: The HP-1 pond is an active double-lined evaporative pond constructed over the area referred to as the former unlined South Nitrate Pond. The HP-1 pond was used to receive cooling tower blowdown and non-contact cooling water since 1976 and leach liquor from 1976 to 1990. Primary liner failure was documented in 1989. In 2013, accumulated solids and water from HP-1 was removed and disposed off-site and the pond was re-lined. The HP-1 pond is currently used to collect and evaporate WCF brine.
- PSA 7 – HP-6 Pond: The HP-6 Pond is an active double-lined evaporation pond constructed in 1991 and used to store leach liquor and spent caustic wastewater. The HP-6 pond is currently used to collect and evaporate WCF brine.
- PSA 8 – Old Caustic Pond/CSD Stockpile: This area contains an abandoned, unlined caustic wastewater disposal and evaporation pond. Caustic liquids discharged to the caustic pond include spent caustic scrubber water used to remove chlorine gas from the chlorination process and the magnesium recovery process. From the late 1970s until early 1991, dredged CSD solids from the CSD north and south ponds were stockpiled in this area and allowed to dry through evaporation and gravity drainage of liquids. Dried CSD solids were removed from the old caustic pond and this area is currently inactive.
- PSA 27 – BMI J-9 Tailings Ponds: This area consists of two former small tailings ponds (approximately 0.23 acres each) used by BMI from 1942 to 1944 for discharge of magnesium-manufacturing wastes. The tailings ponds were constructed of concrete and wood and the reservoirs were open to the surface. A portion of the J-9 tailings ponds were capped during the construction of the WCF. An NFA was issued by NDEP for the WCF construction area.

4.5.4 J2 Landfill Area (Source Area 4)

This source area includes the following four PSAs and their associated waste streams:

- PSA 16 – Used Paints and Solvent Area: This is an area on the J-2 Landfill cap that was used to store used paint and solvent from the paint shop. The paint and solvent were stored in drums on pallets. There are no records or evidence of spills or disposal of paint/solvent mixtures in this area.
- PSA 30 – J2/S-18 Landfill: The S-18 Landfill was operated by Pioche Manganese from 1954 to 1958. The S-18 Landfill is contiguous and to the south of the current J-2 Landfill. The J-2 Landfill was purchased by TIMET in 1979 from Pioche Manganese. Manganese slag was a major waste produced by Pioche Manganese. The J-2 Landfill is currently in operation and receives nonhazardous wastes, including inert metals and salts, construction debris, and packing materials. The original unlined landfill operated as a cut-and-fill landfill constructed with a low earth barrier upgradient of the landfill to divert

surface runoff around the landfill. The landfill was measured as approximately 7.2 acres in size during an EPA aerial reconnaissance. The J-2 Landfill cell at the north end of the landfill is lined.

- PSA 33 – Rubble and Debris: The source of the rubble and debris reported in the ECA (Law Engineering, 1993) is unknown but is believed to be scrap material that was relocated.

4.5.5 Current and Historical Operational Areas (Source Area 5)

This source area includes the following PSAs and their associated waste streams:

- PSA 4 – Pioche Manganese Landfill (also referred to as S-20): This is the location of a former manganese slag stockpile from Pioche Manganese operations. The area was graded during the late 1960s to early 1970s. The graded area is used for equipment storage.
- PSA 13 – Rutile Off-Loading Area: Area where Rutile ore is off-loaded from rail cars and transferred to a storage area. Best management practices are addressed in the stormwater pollution prevention plan.
- PSA 15 – Material and Equipment Storage Area East of Building J2: This is an area used for storage of incoming new and replacement equipment, bulk (drummed) materials, and other items used at the TIMET facility. The storage area is partially asphalted. Several 55-gallon unopened drums of TCE solvents located on wooden pallets over soil were observed in this area during the Phase I site reconnaissance (Law Engineering, 1983). A 2,000-gallon, single-walled steel UST containing leaded gasoline was installed in 1967 and removed in 1991. The UST and contaminated soils were removed. A soil venting system was installed in the excavated area to remediate remaining contamination. Three reports have been submitted to NDEP and Clark County Health Department.

4.6 Principal Chemicals

The principal categories of chemicals potentially present in PSAs on the site include:

- Metals
- Anions
- Radionuclides
- VOCs
- Water Quality Indicators

- Polycyclic Aromatic Hydrocarbons (PAH)
- PCBs (aroclor and congeners)
- Dioxins
- Asbestos

The principal chemical categories associated with each PSA were identified based on a review of the waste streams managed in the area, waste stream components, and a review of existing soil data. Asbestos was added as a principle chemical based on NDEP comments on the 2007 CSM Report. The principal chemicals listed on Table 4-2 are subsets of the SRCs associated with the PSAs. The list of principal chemicals is not intended to eliminate any SRC from further consideration and broad suites of analyses were conducted for this CSM.

5. Site Remediation Summary

5.1 CSD Ponds and Francy's Mountain Interim Removal Actions (2005)

In 2005, TIMET conducted interim removal actions that resulted in the removal of approximately 18,000 tons of pond solids and waste material from the Plant Site. The excavation areas targeted were the CSD Ponds and Francy's Mountain. These areas are depicted on Figure 4-4 and described below.

From the 1950s to the 1970s, wastes from the chlorination process, scrap reclaim, and the purification process were discharged to the CSD ponds. Beginning in the 1970s, CSD solids slurried with OPW effluent, sponge water, wet scrubber effluent from the leaching process, and makeup water from chlorination process wash towers were neutralized with lime and discharged into the CSD north and south ponds. The ponds were earthen bermed and unlined. Mixed chlorinator dust and CSD solids from the CSD ponds were placed directly over native soil at the location referred to as Francy's Mountain.

In 2005 waste solids from Francy's Mountain and the CSD ponds were excavated, blended, and transported via railcar to an approved facility for disposal. At the completion of the CSD ponds removal action, the ponds were lined with reinforced polyethylene liners. Material piled at Francy's Mountain was removed approximately to existing grade. After removal of Francy's Mountain, the disturbed area was treated with a stabilization compound, reportedly to reduce migration of surface soils or residual waste material. Additional follow-up excavation at Francy's Mountain is discussed in Sections 5.3.1.

5.2 Beta and Northwest Ditches Remediation (2013)

The Beta & Northwest Ditch was a "common drainage ditch" that flowed from west to east across the northern portion of the BMI Complex. Remediation of the TIMET portion of the ditch was completed during 2013 in accordance with the Remedial Action Work Plan (RAWP) (GEI, 2013a). The soil excavation project began with equipment mobilization on August 5, 2013 and was completed with demobilization by October 18, 2013.

The remedial action objective (RAO) as specified in the RAWP was to remove vadose zone soils exceeding the NDEP outdoor industrial worker direct contact BCLs with the exception of radioisotopes. This RAO included removal of PCBs at concentrations greater than 1 milligram per kilogram (mg/kg) and the removal of soil containing asbestos.

The following is a list of general steps completed during the construction process:

- Mobilization
- Finalize required permits
- Designate equipment laydown area and trailer location
- Modify perimeter fencing for ingress/egress
- Establishment of haul routes with imported Type II material
- Clearing and grubbing
- Construct wheel wash station and security guard post
- Excavation and export of ACM soils
- Demolition of culvert related concrete structures within excavation area
- Excavation and export of non-ACM soils
- Import backfill material
- Backfill excavation area/perform geotechnical testing
- Replace fencing along northern property line
- Establishment of final grades
- Conduct as-built survey
- Permit closures
- Application of dust mitigation palliative
- De-mobilization

A summary of materials excavated from the Beta and Northwest Ditch and disposed of site is as follows:

The excavated materials included asbestos containing materials (ACM, soils identified by the Site inspector to potentially contain asbestos), soils identified by the Site inspector to not contain asbestos (non-ACM), grubbing and debris materials including crushed concrete culvert material, and scrap metal from concrete culvert structures rebar. The approximate quantities removed during the remediation activities are:

Type	Tons
ACM	15,368 Tons
Non-ACM	41,462 Tons
Clearing & Grubbing Debris	572 Tons
Scrap Metal	13 Tons

All excavated material was approved for non-hazardous off-Site disposal at the Apex Landfill located at 13550 North Highway 93, in Apex, Nevada. The final excavation grades are as shown on Figure 5-1.

Soil samples were collected from the excavation bottom during the excavation work in accordance with the Excavation Plan Technical Memorandum. Figure 5-2 provides the sample locations. As noted in the RAWP-Rev2, this sampling was done to document residual concentrations in locations where there were no sample results at the final excavation depth. The samples were tested for predetermined analytes specifically, those that exceeded the outdoor industrial worker Basic Comparison Levels (BCLs) in the pre-excavation characterization samples at each specific location. Analytes included hexachlorobenzene, polychlorinated biphenyls (PCBs), dioxins/furans, and niobium. These are the only analytes that could not be confirmed to meet the BCLs and remedial action objective (RAO) at all sample locations, though not all of these analytes were required at all locations.

The sample results are presented in Table 5-1, along with pre-excavation analytical data. The results are compared to the outdoor industrial worker BCLs RAO. In eight of the 18 locations, confirmation results for all analytes tested were below outdoor industrial worker BCLs (BD-1, BD-5, BD-13, NW-5, NW-9, NW-17, NW-23, and NW-24). In two other locations (NW-1 and NW-11), PCB results were just slightly above the BCL but met or were very close to the RAO of 1 part per million (ppm).

In the remaining eight locations (BD-2, BD-3, BD-4, BD-16, BD-17, NW-2, NW-20, and NW-8) dioxin/furan concentrations were above the BCLs, and in some cases there are also exceedances of the BCL for hexachlorobenzene and/or PCBs. The most significant exceedance occurred at the sample from location BD-3 (Table 5-1). At the request of NDEP, an additional 43.3 tons of soil from the BD-3 location was excavated on February 11, 2014.

The Beta and Northwest Ditch remediation project is documented in detail in the report titled "Beta/NW Ditches Removal Action Completion Report" (GEI, 2013d)

5.3 Removal Actions (2013-2014)

TIMET conducted additional soil removal actions during 2013-2014. These efforts coincided with earthwork associated with the construction of the groundwater remediation system (see Section 5.5).

5.3.1 Former Francy's Mountain (2014)

The 2005 removal action at Francy's mountain removed the piled material to what was believed to be the pre-existing grade. However, discolored soil beneath the pile was left in place. As described in Section 6.2, the surficial soils left in place contained elevated levels of a number of metals and radionuclides.

During January 31 to February 6, 2014, an additional removal action was conducted by TIMET. A total of 7,210 tons of soil (including all visibly discolored soil) was removed from the former Francy's Mountain footprint as shown on Figure 5-3.

5.3.2 Northern Storage Area Soil and Debris Pile (2013)

A soil and debris pile was removed from the Site in during February 7 to February 12, 2014 (Figure 5-3). A total of 4013 tons of material was removed and disposed off-site. The depth of excavation was approximately 2.5 feet.

5.3.3 Mystery Ditch (2014)

During May 31 to June 2, 2014, 1071 tons of discolored soil was excavated from the Mystery Ditch (Figure 5.3). Excavation occurred along the banks and base of the ditch to a depth of approximately 4 feet below the base of the ditch. Post excavation samples were obtained, although the results are still pending at the time of this CMS.

5.4 North Site Cover (2013-2014)

A GCL is being constructed over most of the northern portion of the Site. The cover design is presented in the document titled "Soil Management Plan Slurry Wall/Northern Property" (GEI, 2014a). The extent of the cover is shown on Figure 5-4. The construction, ongoing at the time of this CSM, is scheduled for completion during the summer of 2014.

The North Site Cover is discussed in greater detail in Section 8.0.

5.5 Implementation of Remedy for First Water-Bearing Zone (2013-2014)

The GWTS installation was completed in response to items 6, 7, and 8 of the December 14, 2012, State of Nevada Division of Environmental Protection Finding of Alleged Violation and Order (the "Order") issued to TIMET. The schedule for implementation of the Order was revised by March 19, 2013 and August 22, 2013 NDEP approvals. The Groundwater Treatment System (GWTS) installation was completed in accordance with the Order and revised schedule including "startup operations at a continuous groundwater extraction rate of 11 gallons per minute". This installation and startup was verified and documented by the NDEP March 13, 2014 letter "NDEP Response to: Schedule for Compliance with the December 14, 2012 Finding of Alleged Violation and Order, TIMET Corp. Henderson, Nevada".

TIMET's GWTS scope of work included:

- Construction of a 19 well extraction well/recovery system
- Installation of a lift station and air stripper treatment system that temporarily discharges to six underground injection trenches. Treated water discharge will be rerouted to the TIMET WCF by the end of 2015
- Installation of a 2,410 foot (ft) long by 60 ft deep soil bentonite slurry wall
- Installation of six Underground Injection Control (UIC) Trenches
- Installation of a Programmable Logic Control (PLC) system for GWTS operation
- Excavation and disposal of soil from source areas and slurry wall spoils
- Installation of monitoring wells and piezometers

To document the activities performed under the 2012 Order, two reports have been prepared:

- Slurry Wall Construction Completion and As-Built Report (GEI 2014b)
- GWTS CQA and As-Built Construction Report (GEI 2014c)

The GWTS System was designed as a stand-alone system that includes the collection of groundwater from 19 extraction wells located on approximately 100 ft spacing along the southern boundary of the slurry wall. The extraction wells recover groundwater along the upgradient boundary of the wall. Groundwater is conveyed in piping from the extraction wells to a lift station located at the northern end of the wall adjacent to the extraction well "EwQal-1". Water in the lift station collected from the extraction wells is pumped approximately 1,300 feet southeast to an air stripper for treatment. Water is then gravity discharged from the air stripper to six (6) temporary injection trenches located parallel to the eastern/downgradient boundary of the slurry wall. The injection trenches are permitted under a NDEP UIC permit. The treated water discharge will be rerouted to the TIMET Water Conservation Facility (WCF) by the end of 2015 and use of the injection trenches will cease.

The GWTS layout is shown on Figure 5-5.

6. Site Investigation Summary

TIMET Site investigations used in this CSM are described below.

6.1 Work Performed

Previous investigations at the TIMET facility have focused on the characterization of groundwater and soil. Data from these investigations have been used in the development of this CSM, where applicable. The investigation reports and associated data validation reports are referenced in Section 11.0.

A summary of the activities associated with each investigation is provided in the following sections.

6.1.1 *Environmental Conditions Investigation*

In 1993, a Phase I ECA was conducted at the TIMET facility (Law Engineering, Inc. 1993). Based on the findings of the Phase I ECA and subsequent discussions with TIMET, NDEP issued an LOU dated August 16, 1994, that identified 54 study items on the TIMET facility where additional information or further investigation were recommended. TIMET submitted a response to the LOU dated June 7, 1996, that provided responses and identified some items that required additional investigation. Items requiring additional investigation were addressed in the ECI Workplan (TetraTech 1997). The primary objectives of the ECI were to (1) satisfy the requirements of the LOU, which included characterization of potentially affected media at or near sites identified as requiring additional investigation by TIMET; and (2) collect data of adequate technical quality to support development and evaluation of potential remedial alternatives at the TIMET facility. In total, 120 soil, 10 groundwater, 4 sediment, 3 surface water, and 4 waste samples were collected during the ECI.

6.1.2 *Environmental Conditions Investigation Addendum*

The ECIA was prepared in response to comments on the Draft ECI Report. The ECIA focused on areas of the site requiring further action (Tetra Tech 1999). The primary objectives of the ECIA were to (1) address, in combination with the Final ECI Report, the issues raised in the NDEP comment letter, dated June 10, 1998, and the supplemental review letter, dated July 9, 1998; (2) collect data of adequate technical quality to fill data gaps to help develop and evaluate potential remedial alternatives at the TIMET facility; and (3) provide remedial action plans for areas where the extent of contamination is defined and limited. In total, 102 samples (17 soil [roadway] and sediment and 85 groundwater) were collected during the ECIA. In response to NDEP's comments (NDEP 2003), a revised ECIA report was issued on January 24, 2005 (Tetra Tech 2005a).

6.1.3 Groundwater Monitoring Program

The groundwater monitoring program was conducted as part of the requirements for data collection presented in the ECI Workplan (Tetra Tech 1997) and further developed in the ECIA (Tetra Tech 1999). The purpose of the groundwater investigation was to (1) characterize the distribution of inorganic, organic, and radionuclide analytes in groundwater; (2) characterize the hydraulic characteristics of the aquifer; and (3) evaluate relationships between groundwater chemistry, hydrogeology, and potential sources. The groundwater monitoring conducted prior to 2007 is described in detail in quarterly groundwater monitoring reports submitted to NDEP.

6.1.4 Hydrogeological Characterization

A field sampling effort was undertaken in spring 2006 to address specific data needs identified in the preliminary CSM (Tetra Tech 2004b). The following field activities were conducted as part of the hydrogeologic characterization:

- Installed eight soil borings and groundwater piezometers at the Plant Site boundary to obtain lithologic data as part of a paleochannel assessment
- Installed four upgradient First WBZ groundwater monitoring wells
- Advanced 13 soil borings in PSAs at the Plant Site for vertical delineation of potential impacts from source areas
- Measured water levels in the First WBZ at existing and new wells at the Plant Site and in selected off-site existing wells to generate a regional potentiometric surface map
- Collected groundwater samples from monitoring wells installed at the Plant Site and selected existing off-site wells to assess groundwater downgradient from the Plant Site
- Conducted hydraulic tests at a select list of Plant Site and off-site wells to assess hydraulic conditions of the First WBZ

Additional hydrogeological characterization, including a vertical delineation study, hydraulic testing and development of a water balance for the site was conducted by TIMET in 2008 (TIMET, 2008).

Details regarding the field activities are documented in the above-referenced reports. The findings from these investigations have been used to develop of this CSM.

6.1.5 Background Study (Soils)

Because some analytes are found naturally and may be present due to common/widespread use in the area, a joint background soil study was conducted by BRC and TIMET to collect and

evaluate analytical data that are representative of background conditions at the BMI Complex and Common Areas. The main objective of the study was the development of a representative background soil data set that can be used to evaluate whether concentrations of SRCs detected in site soil samples statistically exceed concentrations of these chemicals in background soil. The results of the background soil study are documented in the Background Soil Summary Report, BMI Complex and Common Areas submitted to the NDEP on March 16, 2007 (TIMET 2007a).

Background samples were collected from soils up to a depth of 10 feet bgs, and were analyzed for metals, anions, and radionuclides. No background soil data have been collected at soil depths greater than 10 feet bgs or in the Muddy Creek soils. The Background Soil Summary Report provides a validated background data set with extensive statistical summaries of the data.

6.1.6 Groundwater Remedial Alternatives Study

Monitoring of groundwater quality at the Plant site began over 20 years ago as part of the permitting process for the management of TIMET's process wastewater and solids. Since that time, the groundwater monitoring network at the facility has been periodically expanded to encompass the entire property and some downgradient locations. Based upon results from the groundwater monitoring, which indicated contaminant transport north from TIMET property boundaries, NDEP requested that TIMET evaluate remedial options for groundwater in the First WBZ. In September 2008 TIMET published the "Remedial Alternative Study for the First Water Bearing Zone" (TIMET 2008b) which recommended hydraulic control at the northern property boundary. Based upon these findings, NDEP issued a Record of Decision (ROD) in February 2009 stipulating installation of a slurry wall and a groundwater extraction to meet remedial objectives. Also, TIMET was directed to address downgradient groundwater in the first WBZ through monitored natural attenuation (MNA) (NDEP 2009).

The groundwater remediation program is discussed in Sections 5.0 and 8.0.

6.1.7 CSM Supplemental Investigation (2013-2014)

The results of the investigations described in Sections 6.1.1 through 6.1.5 were presented and interpreted in the 2007 CSM Report. The 2007 CSM Report and subsequent correspondence with NDEP identified PSAs for which additional characterization should be considered. The Supplemental Investigations described in this section were undertaken to address these data needs as appropriate within the context of site remediation programs which have been developed for the site since 2007 (including construction of a downgradient perimeter barrier wall and groundwater extraction system).

The CSM Supplemental Investigation Work Plan (GEI, 2013c) was submitted to NDEP on December 2, 2013 and approved (with the condition that additional work may be required) by letter dated December 6, 2013. The Work Plan incorporated by reference the TIMET Site-Wide

Generic Sampling and Analysis Plan (SAP) (TIMET 2007c), which contains field sampling protocols and the Quality Assurance Project Plan.

6.1.7.1 CSM Supplemental Investigation Objectives

In consideration of the groundwater remediation activities planned for the site, the primary focus of the CSM Supplemental Investigation was to obtain data for characterization of the following:

1. Potential exposure routes involving wind erosion of site soils (fugitive dust)
2. Potential exposure routes involving water erosion of site soils
3. Potential exposure routes involving direct contact with site soils

The objective of the CSM Supplemental Investigation is to provide data which, when considered with the results of prior sampling programs, will be sufficient to develop remediation or management programs for on-site PSAs (as appropriate).

A secondary objective of the supplemental investigations is to identify soils and/or waste materials present at the site which could represent major sources of mobile, leachable constituents to groundwater. To the extent any such areas are identified, the analyses of potential remediation alternatives would include evaluation of response actions targeted to these materials or areas.

6.1.7.2 CSM Supplemental Investigation Scope

The CSM Supplemental Investigation is focused on characterization of soil and groundwater within the contiguous parcels (Parcels B, C and D) owned by TIMET and on which TIMET's manufacturing, material storage and waste management operations take place. Sample collection is targeted to key PSAs for which additional sampling data is necessary to address specific exposure pathways.

Data gaps identified in the 2007 CSM Report fall into two general categories. First, some identified PSAs were identified as requiring additional investigation because insufficient sample locations were evaluated to complete an exposure pathway assessment. Second, some identified PSAs had insufficient chemical analyses performed for environmental samples collected. Specifically, on a facility-wide basis there was insufficient data presented in the 2007 CSM Report concerning asbestos and PCB presence in surface soils to evaluate fugitive dust and direct contact exposure pathways for these constituents.

As described in Section 4.3, the potential PCB impacts at the site derive from the inadvertent generation of PCBs in the magnesium recovery process. The inadvertent generation of PCBs

was the subject of an extensive investigation conducted by TIMET and its consultant Environmental Resources Management (ERM) in conjunction with USEPA Region 9. The findings of the investigations of inadvertent generation of PCBs are presented in Section 4.3.

In addition to the evaluation of TIMET's manufacturing process, the United States Environmental Protection Agency (USEPA) has directed TIMET to conduct a site-wide investigation of PCB presence, including inadvertently generated non-aroclor PCBs. The CSM Supplemental Investigation was designed to satisfy this request.

In their comments on the 2007 CSM Report, NDEP identified the absence of asbestos sampling as a data gap. Site-wide asbestos sampling for screening purposes was included in the Supplemental Investigation to address this data gap.

6.1.7.3 PSAs Identified for Additional Investigation

GEI identified PSA's for additional investigation based on the review of the 2007 CSM Report and subsequent correspondence between TIMET and NDEP. The supplemental investigations target the following PSAs (PSA and LOU Numbers in accordance with the LOU (NDEP 1994)):

- Northern Storage Area: PSA 1, LOU 2
- "Pond Areas" and vicinity including:
 - CSD North and South Ponds: PSA 2, LOU 19
 - SW-1: PSA 5, LOU 46
 - HP-1: PSA 6, LOU 47
 - HP-6: PSAs 7 and 9, LOU 48
- Drainageways (historic and current) including:
 - "Mystery Ditch": PSA 11, LOU 53
 - Alpha Ditch: PSA 12, LOU 44
 - Back Ditch: PSA 21, LOU 32
- Soils underlying the former location of "Francy's Mountain": PSA 3, LOU 21
- S-17 area: PSA 17, LOU 22
- Spent Caustic Lagoons (no PSA or LOU Number)

- Boneyard: PSA 22, LOU 33
- J2 Landfill: PSA 30, LOU 1
- Southeast property area including:
 - Building K53 (downgradient historic drainage): PSA-23, LOU 34, 30
 - R&D Building (no PSA number)

The general locations of these areas are shown on Figure 4-4. PSAs not listed above are addressed in this CSM based on existing data and/or historical information.

In addition, samples were collected from the following areas of the property:

- An area of the property along the east side of Parcel C (and the north part of Parcel D) which is generally not occupied by permanent facilities (referred to herein as the “Northeast Area”).
- Process Areas in and around Units 7, 8, 9 and 10 in the central portion of Parcel B.

6.1.7.4 CSM Supplemental Investigation Sampling Plan

The CSM Supplemental Investigation sampling plan is summarized on Table 6-1. Table 6-1 lists general parameters that were analyzed. Parameter groups are presented on Table 6-2 (soil) and Table 6-3 (groundwater). Reporting limits and analytical methods are presented in the Generic SAP (TIMET, 2007). Sample locations are shown on Figure 6-1. The sampling rationale for each area is described below.

The basis for the depths of sampling is to collect samples representative of surficial soils (as noted below, this depth will 0-6” bgs) and subsurface soil. The surface soil depth of 0-6” bgs is noteworthy since it represents a departure from past sampling programs conducted at the site for which surface soils were defined as 0-12” bgs. This change was made at the request of NDEP. The subsurface soil depths sampled were limited to the upper 10 to 15 feet of soil. Below this depth, contaminants in soils are a concern primarily as a potential source of groundwater contamination. Groundwater impacts are evaluated using the monitoring well network at the site.

Northern Storage Area:

The Northern Storage Area encompasses the northwest corner of the property as shown on Figure 4-4. Soil samples have been collected from the area but previous efforts have focused primarily on the northern perimeter.

Four soil borings were advanced to depths of 10 to 15 feet as described in Section 3.1 using hollow stem auger and split spoon drilling equipment. One surface soil and one subsurface soil sample were collected from each soil boring. The surface soil sample was collected from the top 6 inches of soil. The subsurface soil sample interval was selected based on visual evidence of impacts or, in the absence of visible impacts, from an interval selected from the soil column based on soil characteristics (with a general preference toward sampling fill materials and relatively finer grained horizons, if present). In addition to the soil borings, five discrete surface soil samples were collected as shown on Figure 6-1.

Samples were analyzed as shown on Table 6-1. Surface and subsurface soil samples were analyzed for metals, anions and radionuclides. Additional surface soil samples were analyzed for PCB congeners, dioxins/furans, PAHs and asbestos as part of the site wide investigation of these parameters.

Pond Areas:

The “Pond Areas” are defined in this CSM to be in and around the following current and historic ponds:

- CSD North and South Ponds (PSA 2)
- SW-1 (PSA 5)
- HP-1 (PSA 6)
- HP-6 (PSAs 7 and 9)

Investigation activities for the Pond Areas are described below.

- **HP-1:** Samples were collected from beneath the liner of HP-1 during a brief window of opportunity (1 day) when the base of the pond was exposed during the pond clean-out and liner replacement conducted in July 2013. On July 10, 2013, six soil borings were advanced with a hand auger to approximately 30 inches below the pond base. From each boring, discrete samples were collected from the top 12 inches and from an interval 20 to 30 inches below the pond base. All samples were analyzed for metals, anions, radionuclides, PCB congeners, SVOCs and dioxins/furans.

The HP-1 sampling was an opportunistic sampling event to coincide with liner removal during the short (1 day) timeframe during which sub-liner soil sample collection and direct observation was possible. The liner removal itself was an unplanned event—the liner was damaged during sediment removal necessitating replacement. The work was not conducted under an approved sampling and analysis plan. However, the methods and analyses performed were discussed with NDEP in advance, and the sampling, analytical,

and validation protocols were in accordance with approved standard operating procedures (SOPs).

- SW-1: Samples of the contents of the SW-1 pond were collected on July 15, 2013. Nine borings in 3 groups were advanced using a hand auger to depths of approximately 5 feet as shown on Figure 6-1. Composite samples were collected by combining samples from each group of 3 borings into one composite sample representative of that portion of the pond. Therefore, a total of 3 composite samples were obtained. Samples were analyzed for metals, anions, radionuclides, PCB congeners, SVOCs, and dioxins/furans.

The SW-1 sampling was not conducted under an approved sampling and analysis plan. However, NDEP was notified in advance that the sampling would be performed, and the sample collection (except for compositing as noted above), analytical methods, and validation protocols were in accordance with approved SOPs.

- Former CSD Ponds: Two soil borings were drilled in each former CSD pond using hollow stem auger and split spoon drilling equipment. The borings were drilled to depths of between 10 and 15 feet below the current base of the ponds. One surface soil and one subsurface soil sample were collected from each soil boring. The surface soil sample was collected from the top 6 inches of soil. The subsurface soil sample interval was selected based on visual evidence of impacts or, in the absence of visible impacts, from an interval selected from the soil column based on soil characteristics (with a general preference toward sampling fill materials and relatively finer grained horizons, if present).

Samples were analyzed as shown on Table 6-1. Soil samples were analyzed for metals, anions and radionuclides. Select surface soil samples were also analyzed for PCB congeners, dioxins/furans, and PAHs as part of the site wide investigation of these parameters.

- Other Pond Area Sampling: In addition to the pond sampling activities described above, soil borings were drilled in areas adjacent to ponds HP-1, HP-6 and SW-1 as shown on Figure 6-1. Boring and sample collection methods were as described above for the CSD ponds. Sample analyses were as listed in Table 6-1. Samples of surface soil were analyzed for metals, anions and PCB congeners. One surface sample was also analyzed for radionuclides, PAHs, and dioxins/furans as part of the site wide investigation of these parameters.

Subsurface samples were analyzed for metals and anions, with one sample also analyzed for radionuclides.

Drainageways:

Drainageway sample locations are shown on Figure 6-1. Soil borings were located in the “Mystery Ditch” (3 borings), the Back Ditch (3 borings), the Alpha Ditch (2 borings) and an unnamed historic drainageway between the Alpha and Back ditches (2 borings). All drain (or have drained in the past) potentially impacted Plant Site areas. Boring and sample collection methods were as described above for the CSD ponds. Sample analyses were as listed in Table 6-1.

Soils Underlying Former Location of Francy’s Mountain:

As discussed in Section 5.3.1, the waste materials constituting Francy’s Mountain were removed and disposed off-site. Removal was completed to the pre-existing grade and no endpoint samples were collected. Potential contaminants primarily include metals, anions, and radionuclides. Four surface soil samples were collected from the area as shown on Figure 6-1. As indicated in Table 6-1, all samples were analyzed for metals, anions, radionuclides, and PCB congeners. In addition, dioxins/furans, PAHs and asbestos were analyzed for two samples as part of the site wide investigation of these parameters.

Note: The samples from Francy’s Mountain were collected in November 2013. These sample locations were excavated in January-February 2014.

S-17 Area:

The S-17 area is suspected to be an area where wooden pallets were stacked and burned in the past. Potential chemical presence includes PAHs and dioxins. Two surface soil samples were collected from the area as shown on Figure 6-1. Samples were analyzed for PAHs and dioxins/furans (Table 6-1). One of the samples was also analyzed for PCB congeners as part of the site-wide PCB investigation.

Caustic Lagoons:

Surface soil samples were collected in each of the two former “caustic lagoons” as shown on Figure 6-1. Samples were analyzed for metals and anions as shown on Table 6-1.

Boneyard:

This is a 3.5 acre area north of the J-2 Landfill and south of Boulder Highway. The area is used for storage of intermediate process materials, titanium fines, titanium scrap storage, equipment storage, other metals storage, and MgCl₂ storage. There are no known waste disposal activities or chemical releases impacting this area, therefore sampling was performed using a “screening level” sampling approach. Four surface soil samples were collected from the area as shown on Figure 6-1. Sample analysis was in accordance with Table 6-1. One surface soil sample was

also analyzed for asbestos, radionuclides, PAHs, and dioxins/furans as part of the site wide investigation of these parameters.

J2 Landfill:

The J-2 Landfill is a permitted facility currently in operation and receives nonhazardous solid wastes, including non-putrescible metals and salts, construction debris, and packing materials. It has been the subject of an investigation for the presence of PCBs as described in the “Self Implementing Cleanup Work Plan for PCBs in the J2 Landfill” (ERM, 2011). The results of this investigation were submitted to USEPA. USEPA issue a letter determining that no additional PCB-related characterization or remediation was required for the J2 Landfill (USEPA, 2013).

The supplemental investigations for the J2 Landfill were designed to verify the extent of waste placement on its west, south and east perimeter. Test pits were excavated at the locations shown on Figure 6-1 to depths of approximately 5 feet below existing grade. Soil was visually inspected for the presence of waste materials. One sample from the bottom of each test pit was submitted for analysis of VOCs.

Southeast Property:

Two areas in the southeast portion of the facility were identified for additional investigation in NDEP’s comments on the 2007 CSM Report including the vicinity of Building K-53 and the facility laboratory. One soil boring was drilled at each of these locations. Boring and sample collection methods were as described above for the CSD ponds. Sample analyses were as listed in Table 6-1.

Northeast Area:

Five soil borings were drilled in this portion of the property. Boring and sample collection methods were as described above for the CSD ponds. Sample analyses were as described in Table 6-1. As at other locations, the analyses for PCB congeners, asbestos and dioxin were conducted as part of the site-wide investigation rather than due to any suspected impacts in this area.

Process Areas:

To investigate general impacts to surface soils around Unit 7, Unit 8, Unit 9, Unit 10 and Unit 11, surface soil samples were collected as shown on Figure 6-1. Samples were analyzed as indicated on Table 6-1. In contrast to all other samples analyzed for PCBs as part of this investigation, three sample locations specifically targeted transformer locations and were therefore analyzed for PCB aroclors rather than PCB congeners.

Two additional First WBZ groundwater monitoring wells were installed at the downgradient portion of this area to provide data concerning whether historic activities in the vicinity have

impacted groundwater. These wells were screened in the First WBZ with the screened interval spanning the (estimated) water table. Groundwater samples were analyzed for VOCs, metals, anions, and radionuclides.

Additional Areas Sampled:

In addition to the areas specifically identified in the CSM Supplemental Investigation Work Plan, samples were collected from several areas where TIMET plans to construct new facilities. Data from two of these areas is available for inclusion in this CSM Report:

- Proposed Pond Area (samples designated with “PP-“ prefix on the distribution maps presented in Section 6.2)
- Area 9 (samples designated with “A 9-“ prefix on the distribution maps presented in Section 6.2).

6.1.7.5 CSM Supplemental Investigation Methodology

As described in the CSM Supplemental Investigation Work Plan, all field activities and laboratory analysis were conducted in accordance with NDEP- approved SOPs and plans. As noted above, the surface soil depth of 0-6” bgs differed from earlier sampling programs conducted at the site for which surface soils were defined as 0-12” bgs.

6.1.7.6 Geologic Logs

Soil boring and well installation logs for the CSM Supplemental Investigation are included in Attachment 5.

6.2 Investigation Results

6.2.1 Data Validation and Usability

For the investigations conducted prior to the CSM Supplemental Investigations, including the groundwater sampling conducted in October 2012 and April 2013 (discussed in Section 6.2.5), the data validation and usability reports are included or referenced in the submittals to NDEP.

Attachment 6 presents Data Validation Summary Report for the soil samples collected for this investigation. Data validation for the groundwater samples collected from the two new monitoring wells in February 2014 are validated in Attachment 6. Data validation for the groundwater samples collected in April 2014 will be included in the Data Validation Summary Report for the First Semester 2014 Groundwater Sampling Event (to be submitted under separate cover).

Based on the evaluation of each data set, greater than 90 percent of the solid data obtained during for the CSM Supplemental Investigation are valid (that is, not rejected) and acceptable for their intended use. Biased data may be used as follows:

- Biased high results, based on spike recoveries, surrogate recoveries, serial dilution results, and blank contamination will be used as the upper limit of concentration for the analyte, recognizing that the actual value may be lower.
- Biased low results, based on sample receipt condition, holding time exceedances, spike recoveries, and serial dilution results will be used as the lower limit of concentration for the analyte, recognizing that the actual value may be higher.

All validated data points are appropriate for use in evaluation against screening levels and risk assessment with the appended qualifiers noted in in Attachment 6 (and on the data presented in Tables 6-4 through 6-12).

6.2.2 Background Soil Concentrations and Comparison Levels

6.2.2.1 Background Soil Summary Report (TIMET 2007)

Because some analytes are found naturally and may be present due to common/widespread use in the area, a joint background soil study was conducted by BRC and TIMET to collect and evaluate analytical data that are representative of background conditions at the BMI Complex and Common Areas. The main objective of the study was to develop a representative background soil data set that can be used to evaluate whether concentrations of SRCs detected in site soil samples exceed concentrations of these chemicals in background soil. The results of the background soil study are documented in the Background Soil Summary Report, BMI Complex and Common Areas submitted to the NDEP on March 16, 2007 (TIMET 2007a).

Background samples were collected from soils up to a depth of 10 feet bgs, and were analyzed for metals, anions, and radionuclides. No background soil data have been collected at soil depths greater than 10 feet bgs or in the Muddy Creek soils. The background soil study is a working document that provides a validated background data set with extensive statistical summaries of the data.

Descriptive summary statistics and a variety of statistical plots are included in the Background Soil Summary Report to facilitate evaluations of site data and site-to-background data comparisons. Where soil background levels are used for comparison in the discussions below, the background soil study is referenced.

6.2.2.2 Comparison Levels

The comparison levels discussed in this Section are for screening purposes and are not action levels or cleanup standards and exceedance does not in and of itself trigger the need for a response action.

The TIMET comparison levels include maximum detected background values from BRC and TIMET (certain naturally occurring chemicals only), the NDEP Basic Comparison Levels (BCLs) for industrial or outdoor worker exposures, and Leaching Based Comparison Levels (LBCLs) derived with a dilution attenuation factor (DAF) equal to 20 (DAF20). Since the future use of the site will be industrial, the BCL for industrial or outdoor worker exposures was selected as the risk-based screening level for soil exposure. The threat to groundwater from chemicals in soil was assessed by comparing the soil result with the DAF20 value. It should be noted that application of DAF20 values are not considered as conservative as screening levels as a DAF equal to 1 (DAF1). DAF1 values assume no attenuation of a contaminant (that is, the concentration in the monitoring well is equal to the soil leachate concentration). Such an assumption (neglecting dilution) would be overly conservative for conditions at the TIMET Site. As described in Section 2.2, infiltration contributes very little flow to the Qal, accounting for approximately 1/20th of the horizontal flow crossing the downgradient boundary of the site. Therefore, the LBCLs based on DAF20 are the appropriate comparison levels for protection of groundwater.

The groundwater screening levels are the NDEP BCLs for residential water.

6.2.3 Chemical Presence in Soil

The distributions of SRCs in surface soil, subsurface soil and groundwater measured during the investigations listed above are described below for the TIMET site as a whole. In Section 7.0, the chemical distributions relative to PSAs are evaluated.

Because the definition of surface soils was changed from the interval 0-12" bgs that was used in TIMET investigations conducted prior to 2013 to the interval 0-6" bgs for the CSM Supplemental Investigation sampling program conducted in 2013-2014, the data presentations below discuss the surface soils (0-6" bgs) separately from the 0- 12" bgs horizon. Data collected prior to 2007 and included in the 2007 CSM Report has been mapped separately. These maps, previously submitted in the aforementioned report are also included herein (in some cases the comparison criteria on these 2007 maps are out of date—the discussions and comparisons below reference only the current comparison levels). The site soils data is organized in the current report as follows:

- Surface Soils Results from Supplemental CSM Investigations: Surface soil results from the CSM Supplemental Investigations are presented in Tables 6-4 through 6-11. Distribution maps and tabulated results for the 0-6" soil samples collected as part of the CSM

Supplemental Investigations are presented herein. Beta Ditch pre-design and confirmatory sampling results are also included with this data set.

- Shallow Soils Results 2007 CSM Report (0-12" bgs): Mapped results of chemical concentrations measured in the 0-12" bgs horizon are included herein. These maps were originally submitted with the 2007 CSM Report. In some cases the 2007 maps reference out-of-date comparison levels. Except as noted (for radionuclides), the discussions that follow use the updated comparison levels.
- Subsurface Soils Results 2007 CSM Report (greater than 1 foot bgs): Mapped results of chemical concentrations measured in soils deeper than 1 foot bgs are included herein. These maps were originally submitted with the 2007 CSM Report. In some cases the 2007 maps reference out-of-date comparison levels. Except as noted (for radionuclides), the discussions that follow use the updated comparison levels.
- Subsurface Soils results from Supplemental CSM Investigations: Subsurface soil results from the CSM Supplemental Investigations are presented in Tables 6-4 through 6-11. Beta/NW Ditch pre-design and confirmatory sampling results are also included with this data set. Note also that HP-1 soils obtained beneath the liner and composite samples from the contents of SW-1 are discussed with the subsurface soils.

Results are discussed (by chemical group) below.

6.2.3.1 Anions

Inorganic ions found to exceed applicable TIMET screening comparison levels in soil and/or groundwater include nitrate, chloride, sulfate, and total dissolved solids. A discussion of the nature and occurrence of these anions is provided below.

Nitrate:

Nitrate was present in a number of waste streams, including (1) OPW, (2) leach liquor, (3) spent caustic, (4) chlorinator dust, (5) Pioche Manganese slag, and (5) nitric acid. These include both solid wastes and wastewater. Consequently, nitrate may have been present in materials disposed in Pioche Manganese landfill and the northern storage area, or released from subsurface piping, drainage ways and in the ponds areas.

The soil comparison levels used for screening are 10,000 mg/kg (outdoor industrial worker BCL) and 140 mg/kg (LBCL DAF20).

Surface Soil (0-6 inches bgs): The distribution of nitrate measured in surficial soil samples (0 -6" bgs) collected during the Supplemental CMS Investigation is mapped on Figure 6-2. Nitrate concentrations measured in the surface soil samples do not exceed the industrial worker BCL at

any sample location. Nitrate concentrations exceed the LBCL DAF20 of 140 mg/kg at 2 surface sample locations:

- P-B-2 (SW-1-North Berm): 570 mg/kg
- BY-SS-2 (Boneyard): 310 J (estimated) mg/kg

Beta and Northwest Ditch samples collected in May 2011 were also obtained for the 0 to 6 inches depth interval. Nitrate concentrations exceed the LBCL DAF20 of 140 mg/kg for the 0 to 6 inches depth interval at the following sample locations:

- NW-12 (Beta/NW Ditch –subsequently excavated as part of Beta Ditch Remediation): 160 mg/kg
- NW-18 (Beta/NW Ditch perimeter—area not excavated): 190 mg/kg
- BD-6 (Beta/NW Ditch—area of the former ditch that was not excavated): 160 mg/kg
- Duplicate sample, BD-8 (Beta/NW Ditch—area not excavated): 210 mg/kg (note: parent sample result is 73 mg/kg)
- BD-10 (Beta/NW Ditch): 160 mg/kg

Shallow Soil (0-12 inches bgs): The distribution of nitrate in shallow soil samples collected for the 2007 CSM Report is presented in Figure 6-3. Nitrate concentrations measured in the shallow soil samples collected for the 2007 CSM Report do not exceed the industrial worker BCL at any sample location. Nitrate exceeds the LBCL DAF20 of 140 mg/kg at 2 shallow soil sample locations: PM3 (200 J-estimated mg/kg) located just north of the Pioche Manganese Landfill and TMSB-125 (540 mg/kg) located in the Northern Storage Area (location excavated during the Beta Ditch/Northwest Ditches remediation project in 2013).

Subsurface Soil (>1 foot bgs): Nitrate concentrations measured in the subsurface soil samples collected for the 2007 CSM Report do not exceed the industrial worker BCL at any sample location (Figure 6-4). Nitrate exceeds the LBCL DAF20 of 140 mg/kg in only one boring: TMSB-125 at 4 to 5 feet bgs (270 mg/kg). This boring is located just north of the former Nitrate Ponds; however, below a depth of 4 to 5 feet bgs, concentrations fall to 100 mg/kg (9-10 feet bgs), 27 mg/kg (14-15 feet bgs), and 18 mg/kg (19-20 feet bgs).

Nitrate concentrations measured in the subsurface soil samples collected for the Supplemental CSM Investigation do not exceed the industrial worker BCL at any sample location (Figure 6-5). Nitrate exceedances of the LBCL DAF20 of 140 mg/kg in subsurface soils were limited to HP-1 sub-liner samples and Beta Ditch pre-design samples as listed below:

- BD-6 (Beta/NW Ditch, depth 4-5 feet—area of the former ditch that was not excavated): 160 mg/kg
- BD-8 (Beta/NW Ditch, depth 0.5-1.5 feet—area not excavated): 550 mg/kg
- NW-4 (Beta/NW Ditch, depth 10-11 feet –subsequently excavated as part of Beta Ditch Remediation): 160 mg/kg
- HP-1-1-1 (HP-1, depth 0-1.0 feet below bottom liner): 190 J mg/kg
- HP-1-1-2 (HP-1, depth 1.8-2.3 feet below bottom liner): 200 J mg/kg
- HP-1-2-1 (HP-1, depth 0-1.0 feet below bottom liner): 220 J mg/kg
- HP-1-2-2 (HP-1, depth 2.0-2.5 feet below bottom liner): 210 J mg/kg
- HP-1-3-1 (HP-1, depth 0-1.0 feet below bottom liner): 190 J mg/kg
- HP-1-3-2 (HP-1, depth 1.1-1.5 feet below bottom liner): 290 J mg/kg
- HP-1-3-3 (HP-1, depth 2.0-2.5 feet below bottom liner): 190 J mg/kg
- HP-1-4-1 (HP-1, depth 0-1.0 feet below bottom liner): 260 J mg/kg
- HP-1-4-2 (HP-1, depth 1.9-2.5 feet below bottom liner): 240 J mg/kg
- HP-1-6-1 (HP-1, depth 0-1.0 feet below bottom liner): 260 J mg/kg
- HP-1-6-2 (HP-1, depth 2.0-2.5 feet below bottom liner): 150 J mg/kg

Chloride:

Chloride was present in a number of waste streams, including (1) CSD solids, (2) OPW, (3) spent caustic, (4) leach liquor, and (5) chlorinator dust. These include both solid waste and wastewater; therefore, chloride was likely present in materials disposed of in the Ponds Area, J2 Landfill, Surface Ditches and NSA, or may have been released from subsurface piping that conveyed these waste streams. Of these PSAs, the unlined ponds formerly used at the site were likely the most significant source of chloride releases to subsurface soil and groundwater. Not only was the driving force significant (hydraulic head in the pond) but the evaporation occurring in the ponds served to concentrate chloride well above that in the raw wastewaters.

Lesser releases may have occurred from buried wastes at the J2 Landfill. Chloride can also slowly accumulate on soils where water application is used for dust control over extended periods of time.

There are no BCLs for chloride. The comparison level for soils used in this report is the background level of 1,100 mg/kg (see Section 6.2.1).

Surface Soil (0-6 inches bgs): The distribution of chloride measured in surficial soil samples (0 -6" bgs) collected during the Supplemental CMS Investigation and Beta/NW Ditch predesign sampling is mapped on Figure 6-6. Samples exceed the screening level in more than half of the samples collected. Ranges of measured concentrations in surface soils are summarized below:

- Spent Caustic Area: Chloride concentrations range from 11,000 mg/kg to 17,000 mg/kg.
- Northeast Area: Chloride concentrations range from 1,700 mg/kg to 22,000 mg/kg.
- Proposed Pond Area: Chloride concentrations range from 1,100 mg/kg to 12,000 mg/kg.
- Area 9: Chloride concentrations range from 160 mg/kg to 410 mg/kg.
- J2 Landfill Area: Chloride concentrations range from 2,700 mg/kg to 6,600 mg/kg
- Process Areas: Chloride concentrations range from 31 mg/kg to 3,600 mg/kg.
- Pond Areas: Chloride concentrations range from 22 mg/kg to 20,000 mg/kg.
- Francy's Mountain: Chloride concentrations range from 150 mg/kg to 2,300 mg/kg (all sample locations excavated).
- Northern Storage Area: Chloride concentrations range from 18 mg/kg to 6,700 mg/kg.
- Beta/NW Ditch: Chloride concentrations range from 12 mg/kg to 14,000 mg/kg (maximum sample from a location not excavated).
- Other Drainage Ditches: Chloride concentrations range from 2.2 J mg/kg to 2,000 J mg/kg.

Shallow Soil (0-12 inches bgs): The occurrence of chloride above the screening level in shallow soil samples collected for the 2007 CSM Report is limited to the vicinity of the Pioche Manganese Landfill at TMSB-120 and PM-3, the J2 Landfill at TMSB-120, and at borings IDN-12-01 and TMSB-109 (along remnants of the former Alpha and Beta Ditches) and TMSB-125, which is located in the NSA just north of the Ponds Area (Figure 6-7).

Subsurface Soil (>1 foot bgs): Chloride concentrations measured in the subsurface soil samples collected for the 2007 CSM Report are shown on Figure 6-8. The chloride comparison level was exceeded in samples from the J2 landfill and from the Ponds Area.

The distribution of chloride measured in subsurface soil samples (greater than 0.5 feet bgs) collected during the Supplemental CMS Investigation and Beta/NW Ditch predesign sampling is mapped on Figure 6-9. Compared to the surface sample results, subsurface samples contained lower chloride concentrations. Limited exceedances of the background comparison level were found outside of the Beta/NW Ditch and HP-1 sub-liner areas. The comparison level is exceeded at the following locations:

- NE-B-1 (Northeast Area, depth 8-13 feet): 3,700 J mg/kg
- NE-B-6 (Northeast Area, depth 5-6.5 feet): 9,400 mg/kg
- NE-B-6 (Northeast Area, depth 10-11.5 feet): 8,300 mg/kg
- BD-6 (Beta/NW Ditch, depth 4-5 feet—area of the former ditch that was not excavated): 9,100 mg/kg
- BD-6 (Beta/NW Ditch, depth 9-10 feet—area not excavated): 5,200 mg/kg
- BD-6 (Beta/NW Ditch, depth 22-23 feet—area not excavated): 1,200 mg/kg
- BD-7 (Beta/NW Ditch, depth 0.5-1.5 feet—area not excavated): 1,300 mg/kg
- BD-7 (Beta/NW Ditch, depth 4-5 feet—area not excavated): 3,900 mg/kg
- BD-7 (Beta/NW Ditch, depth 9-10 feet—area not excavated): 1,500 mg/kg
- BD-8 (Beta/NW Ditch, depth 0.5-1.5 feet—area not excavated): 3,700 mg/kg
- BD-8 (Beta/NW Ditch, depth 4-5 feet—area not excavated): 1,800 mg/kg
- BD-8 (Beta/NW Ditch, depth 9-10 feet—area not excavated): 1,400 mg/kg
- BD-8 (Beta/NW Ditch, depth 19-20 feet—area not excavated): 1,500 mg/kg
- NW-4 (Beta/NW Ditch, depth 10-11 feet--subsequently excavated as part of Beta Ditch Remediation): 4,300 mg/kg
- NW-6 (Beta/NW Ditch, depth 0.5-1.5 feet – subsequently excavated as part of Beta Ditch Remediation): 2,000 mg/kg

- NW-7 (Beta/NW Ditch, depth 0.5-1.5 feet – subsequently excavated as part of Beta Ditch Remediation): 1,400 mg/kg
- NW-12 (Beta/NW Ditch, depth 0.5-1.5 feet –area not excavated): 1,800 mg/kg
- NW-14 (Beta/NW Ditch, depth 19-20 feet –area not excavated): 1,300 mg/kg
- NW-14 (Beta/NW Ditch, depth 21-22 feet –area not excavated): 1,200 mg/kg
- NW-19 (Beta/NW Ditch, depth 0.5-1.5 feet –area not excavated): 1,900 mg/kg
- HP-1-1-1 (HP-1, depth 0-1.0 feet below bottom liner): 7,700 J mg/kg
- HP-1-1-2 (HP-1, depth 1.8-2.3 feet below bottom liner): 7,200 J mg/kg
- HP-1-2-1 (HP-1, depth 0-1.0 feet below bottom liner): 7,000 J mg/kg
- HP-1-2-2 (HP-1, depth 2.0-2.5 feet below bottom liner): 7,400 J mg/kg
- HP-1-3-1 (HP-1, depth 0-1.0 feet below bottom liner): 8,100 J mg/kg
- HP-1-3-2 (HP-1, depth 1.1-1.5 feet below bottom liner): 13,000 J mg/kg
- HP-1-3-3 (HP-1, depth 2.0-2.5 feet below bottom liner): 8,500 J mg/kg
- HP-1-4-1 (HP-1, depth 0-1.0 feet below bottom liner): 8,200 J mg/kg
- HP-1-4-2 (HP-1, depth 1.9-2.5 feet below bottom liner): 8,100 J mg/kg
- HP-1-5-1 (HP-1, depth 0-1.0 feet below bottom liner): 16,000 J mg/kg
- HP-1-5-2 (HP-1, depth 1.9-2.5 feet below bottom liner): 15,000 J mg/kg
- HP-1-6-1 (HP-1, depth 0-1.0 feet below bottom liner): 7,900 J mg/kg
- HP-1-6-2 (HP-1, depth 2.0-2.5 feet below bottom liner): 5,000 J mg/kg

Sulfate:

Sulfate is present in CSD, leach liquor, spent caustic, and OPW wastewater, and as such, was primarily disposed of on site in liquid waste streams. As a result, the Ponds Area is a likely PSA for discharge of sulfate to shallow and subsurface soil. The drainage ditches and underground piping may also have contained sulfate bearing wastewaters via conveyance to the Pabco Road Ponds Area. There are no BCLs for sulfate. The comparison level for soils used in this report is the background level of 4,130 mg/kg (Section 6.2.1).

Surface Soil (0-6 inches bgs): The distribution of chloride measured in surficial soil samples (0 -6" bgs) collected during the Supplemental CMS Investigation and Beta/NW Ditch predesign sampling is mapped on Figure 6-10. The comparison level for sulfate was exceeded in 2 areas. There were marginal exceedances at 3 locations within Francy's Mountain (4,200 J mg/kg to 4,400 J mg/kg), all of which were excavated in 2014 (see Section XX). Exceedances were also measured in 3 samples from in the spent caustic area (ranging from 6,500 J mg/kg to 12,000 J mg/kg).

Shallow Soil (0-12 inches bgs): Sulfate was not measured above the screening level in shallow soil samples collected for the 2007 CSM Report (Figure 6-11).

Subsurface Soil (>1 foot bgs): Sulfate concentrations measured in the subsurface soil samples collected for the 2007 CSM Report are shown on Figure 6-12. The sulfate comparison level was exceeded in two subsurface soil samples, both obtained at boring TSMB-104 (34 to 35 feet bgs and 39 to 40 feet bgs).

The distribution of sulfate measured in subsurface soil samples (greater than 0.5 feet bgs) collected during the Supplemental CMS Investigation and Beta/NW Ditch predesign sampling is mapped on Figure 6-13. Exceedance of the comparison level is limited to one HP-1 sub-liner sample and 7 samples from the Beta/NW Ditch as listed below:

- HP-1-5-2 (HP-1, depth 1.0-2.0 feet below bottom liner): 11,000 J mg/kg
- BD-8 (Beta/NW Ditch, depth 0.5-1.5 feet—area not excavated): 7,200 mg/kg
- BD-8 (Beta/NW Ditch, depth 9-10 feet—area not excavated): 5,000 mg/kg
- BD-9 (Beta/NW Ditch, depth 30-31 feet—area not excavated): 20,000 mg/kg
- BD-11 (Beta/NW Ditch, depth 34-35 feet—area not excavated): 12,000 mg/kg
- NW-14 (Beta/NW Ditch, depth 9-10 feet—area not excavated): 5,000 mg/kg
- NW-14 (Beta/NW Ditch, depth 19-20 feet—area not excavated): 5,300 mg/kg
- NW-19 (Beta/NW Ditch, depth 29-30 feet –area not excavated): 17,000 mg/kg

Perchlorate:

Perchlorate is not associated with TIMET processes or waste streams. Ammonium perchlorate and other perchlorate compounds were manufactured and are known to have been released to soil and groundwater at the NERT facility west and adjacent to the TIMET Plant Site. Perchlorate was also manufactured at the AMPAC site located further to the west.

The soil comparison levels used for screening are 795 mg/kg (outdoor industrial worker BCL) and 0.526 mg/kg (LBCL DAF20).

Surface Soil (0-6 inches bgs): Perchlorate was not analyzed in samples collected during the Supplemental CMS Investigation. It was sampled for the Beta/MW Ditch predesign investigations (Figure 6-14). The outdoor industrial worker BCL was not exceeded at any location.

Shallow Soil (0-12 inches bgs): Of the 23 shallow soils samples analyzed for perchlorate, 17 samples exhibited detectable concentrations ranging from 0.063 to 70 mg/kg, The outdoor industrial worker BCL was not exceeded at any location.

Subsurface Soil (>1 foot bgs): Of the 171 subsurface samples analyzed for perchlorate for the 2007 CSM, 114 samples exhibited detectable concentrations ranging from 0.051 to 18 mg/kg. The outdoor industrial worker BCL was not exceeded at any location.

Perchlorate results from the Beta/MW Ditch predesign investigations are shown on Figure 6-15. The outdoor industrial worker BCL was not exceeded at any location.

6.2.3.2 Metals

Arsenic:

Arsenic has been neither suspected nor detected in historic or current waste streams. It is naturally present in site soils. The soil comparison levels for arsenic are 7.2 mg/kg (background value) and 20 mg/kg (LBCL DAF20).

Surface Soil (0-6 inches bgs): The distribution of arsenic measured in surficial soil samples (0 -6" bgs) collected during the Supplemental CMS Investigation and Beta/NW Ditch predesign sampling is mapped on Figure 6-16. Shallow soil data were less than the screening level of 7.2 mg/kg, except in nine samples:

- PP-B-3 (Proposed Pond Area), 8.4 mg/kg
- DD-B-1 (Mystery Ditch), 8.4 mg/kg
- NS-SS-1 (NSA), 8.5 mg/kg
- NS-B-1 (NSA), 7.5 mg/kg
- NS-B-2 (NSA), 20 mg/kg
- NS-B-3 (NSA), 18 mg/kg

- NS-B-4 (NSA), 9.5 mg/kg
- PA-SS-5 (process area north of Unit 9), 8.6 mg/kg
- PA-SS-8 (process area east of Pioche Manganese Landfill).

Shallow Soil (0-12 inches bgs): Shallow soil data were less than the screening level of 7.2 mg/kg, except in three samples (Figure 6-17): one sample from boring TMSB-124, located just west of the Ponds Area, and two samples from the Pioche Manganese Landfill (PM-1 and PM-2). The arsenic concentration in the sample from TMSB-124 slightly exceeded (7.5 mg/kg) the comparison level (7.2 mg/kg). Arsenic concentrations in the samples from PM-1 and PM-2 were measured at 25.7 mg/kg and 18 mg/kg, respectively.

Subsurface Soil (>1 foot bgs): Arsenic concentrations measured in the subsurface soil samples collected for the 2007 CSM Report (Figure 6-18) exceed the background soil concentration in the following samples (three of which also exceed the LBCL of 20 mg/kg):

- TMSB-120 (J2 Landfill): 13 mg/kg (4-5 feet) and 15 mg/kg (9-10 feet)
- PM1 (Pioche Manganese Landfill) 61.2 mg/kg (1.0-1.5 feet) and 22.5 mg/kg (2.0-2.5 feet)
- TMSB-106 (Beta/NW Ditch) 9.2 mg/kg (24-25 feet)
- TMSB-107 (Beta/NW Ditch) 8.3 mg/kg (24-25 feet)
- TMSB-125 (Beta/NW Ditch) 7.4 mg/kg (14-15 feet) and 12 mg/kg (19-20 feet)
- TMMW-101 through TMMW-104 (upgradient locations). Exceedances occurred in the 39-40 feet depth interval (9.4 mg/kg at TMSB-101, 13 mg/kg at TMSB-102, 16 mg/kg at TMSB-103, and 14 mg/kg at TMSB-104), in the 64-65 feet depth interval (8.6 mg/kg at TMSB-102, 11 mg/kg at TMSB-103, and 12 mg/kg at TMSB-104), and in the 69-70 feet depth interval (20 mg/kg at TMSB-101). No samples were collected from intervals between the exceedances.

The distribution of arsenic measured in subsurface soil samples (greater than 0.5 feet bgs) collected during the Supplemental CMS Investigation and Beta/NW Ditch predesign sampling is mapped on Figure 6-19. Most of the exceedances of comparison levels occurred in and around the Beta/NW Ditch.

Beta/NW Ditch exceedances and location dispositions with respect to the 2013 removal action are listed below:

- NW-1 (not excavated), 19-20 (15 mg/kg)

- NW-2 (not excavated), 19-20 (36 mg/kg)
- NW-3 (not excavated), 27-28 (29 mg/kg)
- NW-4 (not excavated), 28-29 (30 mg/kg)
- NW-5 (excavated), 9-10 feet (8.1 mg/kg)
- NW-5 (not excavated), 19-20 (10 mg/kg) and 20-21 feet (11 mg/kg)
- NW-6 (not excavated), 22-23 feet (26 mg/kg), and 24-25 feet (15 mg/kg)
- NW-7 (not excavated), 26-27 feet (8.7 mg/kg)
- NW-8 (not excavated), 22-23 feet (8.9 mg/kg)
- NW-9 (not excavated), 26-27 feet (9.1 mg/kg)
- NW-10 (not excavated), 13-14 feet (7.7 mg/kg) and 28-29 feet (8.9 mg/kg)
- NW-11 (not excavated), 19-20 feet (7.6 mg/kg)
- NW-14 (not excavated), 19-20 feet (7.3 mg/kg)
- NW-15 (not excavated), 19-20 (8.1 mg/kg) and 29-30 feet (9.4 mg/kg)
- NW-17 (not excavated), 28-29 feet (9.1 mg/kg)
- NW-18 (not excavated), 28-29 feet (14 mg/kg)
- NW-19 (not excavated), 29-30 feet (11 mg/kg)
- NW-20 (not excavated), 12-13 feet (12 mg/kg), 15-16 feet (93 mg/kg) and 19-20 feet (24 mg/kg)
- NW-21 (not excavated), 12-13 feet (17 mg/kg), 15-16 feet (7.8 mg/kg) and 19-20 feet (11 mg/kg)
- NW-23 (excavated), 9-10 feet (9.5 mg/kg)
- BD-1 (not excavated), 19-20 feet (30 mg/kg)
- BD-3 (not excavated), 27-28 feet (30 mg/kg)
- BD-4 (not excavated), 14-15 feet (10 mg/kg) and 21-22 feet (27 mg/kg)

- BD-5 (not excavated), 27-28 feet (26 mg/kg)
- BD-6 (not excavated), 19-20 feet (7.4 mg/kg) and 22-23 feet (31 mg/kg)
- BD-9 (not excavated), 30-31 feet (20 mg/kg)
- BD-10 (not excavated), 35-36 feet (23 mg/kg)
- BD-11 (not excavated), 34-35 feet (17 mg/kg)
- BD-16 (not excavated), 19-20 feet (20 mg/kg)
- SW-5 (not excavated), 39-40 feet (22 mg/kg)

Elsewhere on the TIMET property, arsenic presence above the comparison level (7.2 mg/kg) is limited to the following sample locations:

- NS-B-2 (NSA), 3-8 feet (7.9 mg/kg)
- NS-B-3 (NSA), 10-15 feet (8.8 mg/kg)
- DD-B-2 (Mystery Ditch), 10-15 feet (10 mg/kg)
- P-B-12 (CSD Ponds), 18-23 feet (14 mg/kg)

The arsenic distribution in site soils is different from contaminants known to have been released at the site. The elevated concentrations relative to the background value are limited largely to:

1. The Beta/NW ditch and nearby soils in the NSA, particularly at depths greater than 10 feet; and
2. Soils in the 45-70 feet depth horizon upgradient of the TIMET facility.

The former could indicate an association with the mixed (and not precisely known) wastewaters from multiple parties which were formerly conveyed by the Beta and Northwest Ditches. However, the prevalence of arsenic in deep samples in both the Beta/NW Ditch area and upgradient samples introduces some complexity in interpreting the arsenic distribution. Most of the chemical data for deep soils at TIMET is from samples obtained for the Beta/NW ditch removal action and along the southern upgradient boundary of the site. Site-wide conclusions regarding deep soils are consequently limited. It does appear likely however that the concentrations measured in TMMW-101 through TMMW-104 (upgradient locations) indicate that natural concentrations of arsenic in deeper soils may be higher than estimated from the shallower samples used for the background study.

Chromium:

Chromium is present in the waste streams, CSD solids, OPW, spent caustic, leach liquor, and chlorinator dust. Disposal areas for these waste streams have included the Ponds Area, the J2 Landfill, drainage ditches and Francy's Mountain. Based on process knowledge (Section 3.3), the chromium in waste streams generated at the Plant Site is trivalent chromium (chromium III). As presented in the 2007 CSM Report, chromium speciation conducted on soil samples shows that the total chromium results in site soils are predominantly comprised of the trivalent species.

Based on the supported assumption that chromium is present in the trivalent form, the soil comparison level used for screening is 10,000 mg/kg (outdoor industrial worker BCL). A DAF20 value has not been established for chromium III.

Surface Soil (0-6 inches bgs): The distribution of chromium measured in surficial soil samples (0 -6" bgs) collected during the Supplemental CMS Investigation is mapped on Figure 6-20. Chromium did not exceed the chromium III comparison level in any sample.

Shallow Soil (0-12 inches bgs): The distribution of chromium in shallow soil samples collected for the 2007 CSM Report is presented in Figure 6-21. Chromium did not exceed the chromium III comparison level in any sample.

Subsurface Soil (>1 foot bgs): Chromium concentrations measured in the subsurface soil samples collected for the 2007 CSM Report are presented in Figure 6-22. Chromium did not exceed the chromium III comparison level in any sample.

The distribution of chromium measured in subsurface soil samples (greater than 0.5 feet bgs) collected during the Supplemental CMS Investigation and Beta/NW Ditch predesign sampling is mapped on Figure 6-23. Chromium did not exceed the chromium III comparison level in any sample.

Magnesium:

Magnesium ore processing was the original activity at the Plant Site. Magnesium chloride has been and continues to be used and recycled in the processing of titanium ore at the Facility. Therefore magnesium is potentially present in past and present wastes generated.

The soil comparison levels used for screening are 100,000 mg/kg (outdoor industrial worker BCL) and 19,500 mg/kg (LBCL DAF20).

Surface Soil (0-6 inches bgs): The distribution of magnesium measured in surficial soil samples (0 -6" bgs) collected during the Supplemental CMS Investigation is mapped on Figure 6-24. Magnesium concentrations measured in the surface soil samples do not exceed the industrial worker BCL at any sample location. Magnesium concentrations exceed the LBCL DAF20 of 19,500 mg/kg at three Beta/NW Ditch sample locations, one NSA sample location, one location

in the Boneyard Area, and three locations in the Process Area. Exceedances are summarized below:

- Beta/NW Ditch: BD-6, not excavated (20,000mg/kg), BD-14, excavated (29,000 mg/kg) and BD-15, excavated (34,000 mg/kg)
- NSA: NS-SS-3 (21,000 mg/kg)
- Boneyard Area: BY-SS-3, Duplicate (20,000 mg/kg). Parent sample did not exceed the comparison level.
- Process Area: PA-SS-4 (31,000 J mg/kg), PA-SS-6 (29,000 J mg/kg), and PA-SS-7 (64,000 J mg/kg)

Shallow Soil (0-12 inches bgs): The distribution of magnesium in shallow soil samples collected for the 2007 CSM Report is presented in Figure 6-25. Magnesium concentrations measured in the shallow soil samples collected for the 2007 CSM Report do not exceed the industrial worker BCL at any sample location. Magnesium exceeds the LBCL DAF20 at one shallow soil sample location: TMSB-121 (sample from 0 to 1 feet bgs) located in the Ponds Area contained 20,000 mg/kg.

Subsurface Soil (>1 foot bgs): Magnesium concentrations measured in the subsurface soil samples collected for the 2007 CSM Report do not exceed the industrial worker BCL at any sample location (Figure 6-26). Exceedance of the LBCL DAF 20 was limited too samples from one boring (TMSB-120 at 4 to 5 and 9 to 10 feet bgs) in the J2 Landfill. Below these depths, at 19-20, 29-30, and 39-40 feet bgs, manganese concentrations drop by over two orders of magnitude and are below the LBCL DSF 20.

Magnesium concentrations measured in the subsurface soil samples collected for the Supplemental CSM Investigation do not exceed the industrial worker BCL at any sample location (Figure 6-27). Magnesium exceedances of the LBCL DAF20 in subsurface soils were measured at seven Beta/NW Ditch samples and one HP-1 sub-liner sample as listed below:

- HP-1-3-2 (HP-1, depth 1.1-1.5 feet below bottom liner): 30,000 J mg/kg
- NW-2 (not excavated), 19-20 (34,000 mg/kg)
- NW-3 (not excavated), 27-28 (43,000 mg/kg)
- NW-20 (not excavated), 19-20 feet (24,000 mg/kg)
- BD-4 (not excavated), 21-22 feet (20,000 mg/kg)
- BD-6 (not excavated), 22-23 feet (47,000 mg/kg)

- BD-9 (not excavated), 30-31 feet (25,000 mg/kg)
- SW-5 (not excavated), 39-40 feet (43,000 mg/kg)

Manganese:

Manganese has only been identified in the Pioche manganese slag waste stream, which was stored and ultimately graded in-place in the Pioche Manganese Landfill S-20. Additionally, Pioche manganese slag may have been disposed of in the J2 Landfill. No other waste streams and storage or disposal areas were identified for manganese-containing wastes.

The soil comparison levels used for screening are 100,000 mg/kg (outdoor industrial worker BCL) and 26.1 mg/kg (LBCL DAF20).

Surface Soil (0-6 inches bgs): The distribution of manganese measured in surficial soil samples (0 -6" bgs) collected during the Supplemental CMS Investigation is mapped on Figure 6-28. Manganese concentrations measured in the surface soil samples do not exceed the industrial worker BCL at any sample location. Manganese concentrations exceed the LBCL DAF20 of 26.1 mg/kg at all sample locations. Concentrations do not show a discernable pattern with respect to particular sources and generally range between 300 mg/kg and 3,000 mg/kg.

Shallow Soil (0-12 inches bgs): The distribution of magnesium in shallow soil samples collected for the 2007 CSM Report is presented in Figure 6-29. Manganese concentrations measured in the shallow soil samples collected for the 2007 CSM Report do not exceed the industrial worker BCL at any sample location. Manganese concentrations exceed the LBCL DAF20 of 26.1 mg/kg at all sample locations with concentrations comparable to the surface soils.

Subsurface Soil (>1 foot bgs): Manganese concentrations measured in the subsurface soil samples collected for the 2007 CSM Report do not exceed the industrial worker BCL at any sample location (Figure 6-30). The most elevated concentrations were measured in the J2 Landfill (waste samples). Manganese concentrations exceed the LBCL DAF20 of 26.1 mg/kg at all sample locations.

Manganese concentrations measured in the subsurface soil samples collected for the Supplemental CSM Investigation do not exceed the industrial worker BCL at any sample location (Figure 6-31). Manganese concentrations exceed the LBCL DAF20 of 26.1 mg/kg at all sample locations.

Titanium:

Titanium is the principal metal in ore being processed at Plant Site. As such, it is suspected to occur in process wastes including spent caustic, leach liquor, CSD solids, and chlorinator dust.

Areas where titanium containing materials may have been released include the Ponds Area, J2 Landfill, Francy's Mountain, and locations in and around the Process Areas.

The soil comparison levels used for screening are 100,000 mg/kg (outdoor industrial worker BCL) and 2,920,000 mg/kg (LBCL DAF20).

Surface Soil (0-6 inches bgs): The distribution of titanium measured in surficial soil samples (0 -6" bgs) collected during the Supplemental CMS Investigation is mapped on Figure 6-32. Titanium did not exceed the comparison levels in any sample.

Shallow Soil (0-12 inches bgs): The distribution of titanium in shallow soil samples collected for the 2007 CSM Report is presented in Figure 6-33. Titanium did not exceed the comparison levels in any sample.

Subsurface Soil (>1 foot bgs): Titanium concentrations measured in the subsurface soil samples collected for the 2007 CSM Report are presented in Figure 6-34. Titanium did not exceed the comparison levels in any sample.

The distribution of titanium measured in subsurface soil samples (greater than 0.5 feet bgs) collected during the Supplemental CMS Investigation and Beta/NW Ditch predesign sampling is mapped on Figure 6-35. Titanium did not exceed the comparison levels in any sample.

Uranium:

Uranium, along with thorium, are two radiological metals that are present in minor quantities in titanium ore. Uranium concentrations, in mass per mass (such as mg/kg), are discussed in this section. Radioisotopes of uranium and thorium, as well as daughter decay products, in terms of activity concentrations are discussed in Section 6.2.3.3.

The soil comparison levels used for screening are 3,400 mg/kg (outdoor industrial worker BCL) and 270 mg/kg (LBCL DAF20).

Surface Soil (0-6 inches bgs): The distribution of uranium measured in surficial soil samples (0 -6" bgs) collected during the Supplemental CMS Investigation is mapped on Figure 6-36. Uranium did not exceed the comparison levels in any sample.

Shallow Soil (0-12 inches bgs): The distribution of uranium in shallow soil samples collected for the 2007 CSM Report is presented in Figure 6-37. Uranium did not exceed the comparison levels in any sample.

Subsurface Soil (>1 foot bgs): Uranium concentrations measured in the subsurface soil samples collected for the 2007 CSM Report are presented in Figure 6-38. Uranium did not exceed the comparison levels in any sample.

The distribution of uranium measured in subsurface soil samples (greater than 0.5 feet bgs) collected during the Supplemental CMS Investigation and Beta/NW Ditch predesign sampling is mapped on Figure 6-39. Uranium did not exceed the comparison levels in any sample.

Vanadium:

Vanadium is present in titanium ore and it therefore may be present in waste streams including CSD solids, OPW, and chlorinator dust. Disposal areas for these waste streams include the Ponds Area, J2 Landfill, and Francy's Mountain.

The soil comparison levels used for screening are 5,680 mg/kg (outdoor industrial worker BCL) and 6,000 mg/kg (LBCL DAF20).

Surface Soil (0-6 inches bgs): The distribution of vanadium measured in surficial soil samples (0 -6" bgs) collected during the Supplemental CMS Investigation is mapped on Figure 6-40. Vanadium did not exceed the comparison levels in any sample.

Shallow Soil (0-12 inches bgs): The distribution of vanadium in shallow soil samples collected for the 2007 CSM Report is presented in Figure 6-41. Vanadium did not exceed the comparison levels in any sample.

Subsurface Soil (>1 foot bgs): Vanadium concentrations measured in the subsurface soil samples collected for the 2007 CSM Report are presented in Figure 6-42. Vanadium did not exceed the comparison levels in any sample.

The distribution of vanadium measured in subsurface soil samples (greater than 0.5 feet bgs) collected during the Supplemental CMS Investigation and Beta/NW Ditch predesign sampling is mapped on Figure 6-43. Vanadium did not exceed the comparison levels in any sample.

Antimony:

Waste streams at the TIMET plant are not known to contain significant concentrations of antimony.

The soil comparison levels used for screening are 454 mg/kg (outdoor industrial worker BCL) and 6 mg/kg (LBCL DAF20).

Surface Soil (0-6 inches bgs): The distribution of antimony measured in surficial soil samples (0 -6" bgs) collected during the Supplemental CMS Investigation is mapped on Figure 6-44. Antimony did not exceed the comparison levels in any sample.

Shallow Soil (0-12 inches bgs): The distribution of antimony in shallow soil samples collected for the 2007 CSM Report is presented in Figure 6-45. Antimony did not exceed the comparison levels in any sample.

Subsurface Soil (>1 foot bgs): Antimony concentrations measured in the subsurface soil samples collected for the 2007 CSM Report are presented in Figure 6-46. Antimony did not exceed the comparison levels in any sample.

The distribution of antimony measured in subsurface soil samples (greater than 0.5 feet bgs) collected during the Supplemental CMS Investigation and Beta/NW Ditch predesign sampling is mapped on Figure 6-47. Antimony did not exceed the comparison levels in any sample.

Barium:

Waste streams at the Plant Site that either contain or potentially contain barium include OPW, Pioche Manganese slag, paint shop solvents, and nonhazardous plant solid wastes (J2 Landfill). Based upon waste stream analysis, barium is not a constituent in CSD solids, leach liquor, spent caustic, chlorinator dust, or rutile residuals.

The soil comparison levels used for screening are 100,000 mg/kg (outdoor industrial worker BCL) and 1,640 mg/kg (LBCL DAF20).

Surface Soil (0-6 inches bgs): The distribution of barium measured in surficial soil samples (0 -6" bgs) collected during the Supplemental CMS Investigation is mapped on Figure 6-48. Barium did not exceed the outdoor industrial worker BCL in any sample. Barium exceeded the LBCL DAF 20 value in one sample (6,100 J mg/kg at NS-SS-3 located in the NSA).

Shallow Soil (0-12 inches bgs): The distribution of barium in shallow soil samples collected for the 2007 CSM Report is presented in Figure 6-49. Barium did not exceed the outdoor industrial worker BCL in any sample. Barium exceeded the LBCL DAF 20 value in only one sample (3,130 mg/kg at PM-1 located in the Pioche Manganese Landfill area).

Subsurface Soil (>1 foot bgs): Barium concentrations measured in the subsurface soil samples collected for the 2007 CSM Report are presented in Figure 6-50. Of the total 161 samples analyzed, none exhibited barium concentrations exceeding the outdoor industrial worker BCL and four exhibited concentrations exceeding the LBCL DAF 20 value. Barium concentrations in sample intervals at boring location PM1 (Pioche Manganese Landfill) exceeded the DAF20 value until 4.5 feet bgs, where concentrations decreased by an order of magnitude. Similar results were reported at boring location TMSB-120 (J2 Landfill), where elevated barium concentrations in the 4-to-5- and 9-to-10-foot sample intervals dropped from a high of 30,000 mg/kg to 190 mg/kg in the 19-to-20-foot sample interval. Both of these sample locations and intervals were reported to be representative of waste-containing zone of the landfill areas.

The distribution of barium measured in subsurface soil samples (greater than 0.5 feet bgs) collected during the Supplemental CMS Investigation and Beta/NW Ditch predesign sampling is mapped on Figure 6-51. Barium did not exceed the comparison levels in any sample.

6.2.3.3 Radionuclides

Radionuclides are naturally occurring in site soils and the rutile ore material used to manufacture titanium. Naturally occurring radionuclides present in the rutile ore include primarily uranium (238U and 235U decay chains), thorium (232Th decay chain), and 40K. Processing of rutile ore to produce and purify titanium results in removal and concentration of other components of rutile ore such as metals and radionuclides in process waste streams. Radionuclides above background conditions are present at the Plant Site in CSD solids, OPW, chlorinator dust, and rutile ore residues. These solid and liquid wastes were disposed on-Site at locations including the Ponds Area, the J2 Landfill, and Francys Mountain.

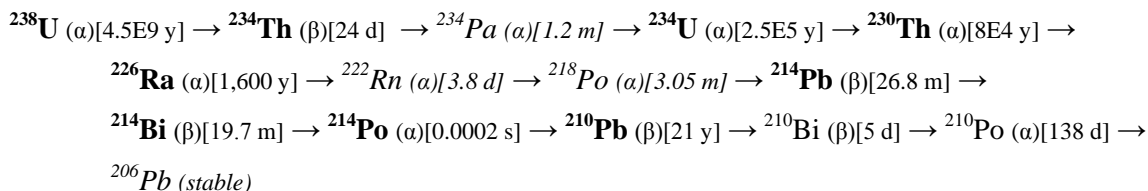
Radionuclides present at the Plant include isotopes of uranium (U), protactinium (Pa), thorium (Th), actinium (Ac), radium (Ra), radon (Rn), polonium (Po), bismuth (Bi), lead (Pb), and thallium (Tl). The various isotopes of these elements are derived via decay from 238U, 232Th, and 235U. The decay chain elements are followed by whether the subsequent decay is alpha (α) or beta (β), followed by the half life in years (y), days (d), minutes (m), or seconds (s). Half-lives are provided to assist in understanding non-detects, which may result from very short half-lives, thereby making detection problematic. Many of the isotopes in these decay chains have half-lives of seconds and minutes—others millions of years. This, in turn, affects the ability to detect these isotopes.

2007 CSM DATA PRESENTATION AND INTERPRETATION:

For radioisotopes, the data and interpretations presented in the 2007 CSM and 2013-2014 Supplemental CSM Investigations are discussed separately. The soil comparison levels used for screening are in units of activity (pCi/g). The soil screening levels used in the 2007 CSM are the (now superseded) EPA Region 9 industrial PRG and the DAF20 value for soil leaching to groundwater. These comparison levels are also presented herein as the analysis and conclusions based on the 2007 CSM remain pertinent.

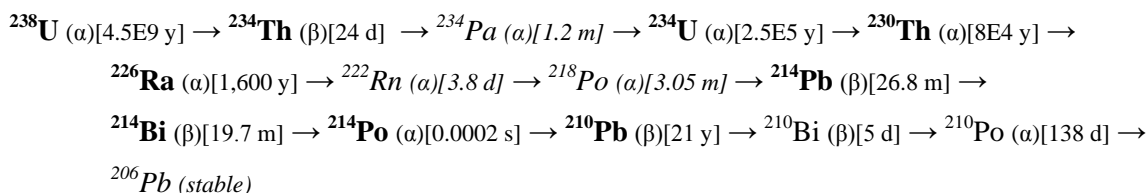
Uranium-238 Decay Series:

Shallow Soil (0-12 inches bgs), 2007 CSM: The distribution of uranium-238 and selected decay chain daughter products (230Th, 226Ra, 210Pb) in shallow soil samples obtained for the 2007 CSM are shown on Figure 6-52. The detections in the uranium-238 decay chain in shallow soil are highlighted (large bold font) in the decay chain below (radionuclides shown in italics were not analyzed).



Of the radionuclide occurrences in shallow soil in the uranium-238 decay chain highlighted above, not all exceed the screening level for soil (Region 9 Outdoor Worker PRG) and soil leaching to groundwater (DAF20 value). However, it should be remembered that most of these elements (particularly including radon) are present throughout the U.S., and their detection does not mean a TIMET-generated release has been detected. Those radionuclides exceeding the screening levels, followed by number of detections exceeding each screening level (PRG, DAF20 value), include: 238U (0, 3), 226Ra (5, 14), and 210Pb (1, 3). Only a small percentage of all detections exceeded the respective screening levels. In most cases, the activities detected for radionuclides only slightly exceeded the screening level for soil.

Subsurface Soil (>1 foot bgs), 2007 CSM: The distribution of uranium-238 and selected decay chain daughter products (230Th, 226Ra, 210Pb) in subsurface soil are shown on Figure 6-53. The detections in the uranium-238 decay chain in subsurface soil are highlighted (large bold font) in the decay chain below. Radionuclides shown in italics were not analyzed.

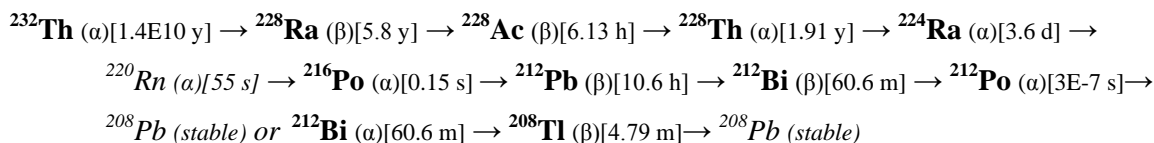


Of the uranium-238 decay isotope occurrences in subsurface soil (highlighted above), the detections exceeding screening level are similar to those for shallow soil. These radionuclides followed by the number of occurrences above each screening level (PRG, DAF20 value), include: 238U (0, 8), 230Th (1, 2), 226Ra (5, 16), and 210Pb (3, 7). Only a small percentage of all detections exceeded both screening levels.

Thorium-232 Decay Series:

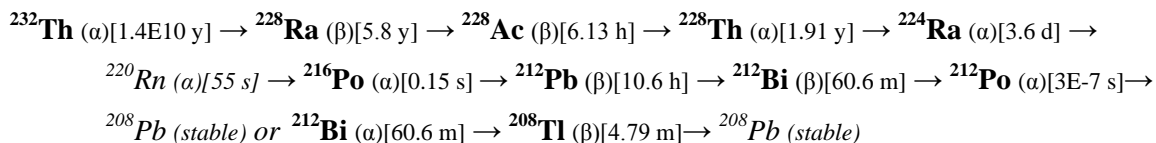
Thorium-232 constitutes 99.99 percent of natural crustal thorium; therefore, it is considered in this CSM to constitute the primary thorium isotope present (in minor quantity) in the titanium ore. The soil screening levels for Thorium-232 used in the 2007 CSM are based on the EPA Region 9 Outdoor Worker PRG and the DAF20 value for soil leaching to groundwater.

Shallow Soil (0-12 inches bgs), 2007 CSM: The distribution of 232Th and 228Ra in shallow soil as presented in the 2007 CSM is shown on Figure 6-54. The detections in the 232Th decay chain in shallow soil are highlighted (large bold font) in the decay chain below. Radionuclides shown in italics were not analyzed.



Of the radionuclide occurrences in shallow soil in the ^{232}Th -chain highlighted above, only two exceeded screening levels (PRG, DAF20 value), including ^{228}Ra (0, 1) and ^{212}Po (1, 0). Only a small percentage of all detections exceeded the respective screening levels.

Subsurface Soil (>1 foot bgs), 2007 CSM: The distribution of ^{232}Th and ^{228}Ra in subsurface soil are shown on Figure 6-55. The detections in the ^{232}Th decay in subsurface soil are highlighted (large bold font) in the decay chain below. Radionuclides shown in italics were not analyzed.



Of the radionuclide occurrences in subsurface soil in the ^{232}Th -chain highlighted above, the same isotope as in shallow soil exceeded screening levels (PRG, DAF20): ^{228}Ra (0, 5).

2013-2014 SUPPLEMENTAL CSM DATA PRESENTATION AND INTERPRETATION:

The data presented in the 2007 CSM Report (as summarized above) did not identify any widespread presence of radionuclide contamination (above the screening levels in use at the time) in soils at the site. The results of the 2013-2014 supplemental CSM Investigations are consistent with this finding as presented below.

The 2013-2014 results were compared to the outdoor industrial worker BCL.

Surface Soil (0-6 inches bgs): The primary radionuclides present in soil above the outdoor industrial worker BCLs are ^{228}Th , ^{226}Ra and ^{228}Ra . The distributions of these radionuclides in surface soils are depicted in Figure 6-56. The comparison criteria are exceeded at all sample locations and concentrations do not vary substantially across the site. In general, results are approximately equal to or below the background concentrations (3.01 pCi/g for ^{228}Th , 2.36 pCi/g for ^{226}Ra and 2.94 pCi/g for ^{228}Ra) -- the exception being a single elevated sample from Francy's Mountain (which was subsequently excavated in 2014).

Subsurface Soil (>1 foot bgs): The primary radionuclides present in soil above the outdoor industrial worker BCLs are ^{228}Th , ^{226}Ra and ^{228}Ra . The distributions of these radionuclides in subsurface soils are depicted in Figures 6-57a, 6-57b and 6-57c. The comparison criteria are exceeded at all sample locations and concentrations do not vary substantially across the site. In general, results are approximately equal to or below the background concentrations.

6.2.3.4 Asbestos

ACM was present as insulation material on certain plant piping and tanks and building siding (galbestos). Formerly, building demolition waste containing asbestos was placed in the J2 Landfill. The Northern Storage Area was identified in previous investigations as containing a debris pile with potential ACM (this has been removed as described in SectionXX). Sampling and analysis for asbestos was not performed for the 2007 CSM.

There are no BCLs for asbestos in soil. At the adjacent NERT site, risk-based asbestos screening levels were developed for use in planning remediation activities including excavation of the portion of the Beta Ditch on the NERT site. The screening levels developed by NERT are as follows (Tronox LLC, July 13, 2010):

- Long chrysotile fibers: greater than 5
- Long amphibole fibers: 1 or more

For the 2013-2014 CSM Supplemental Investigations, surface samples were collected at 14 locations in accordance with the Work Plan. Geotechnical & Environmental Services (GES), under contract with the GEI Consultants conducted the asbestos surface soil sampling at the Timet Facility in Henderson Nevada on November 18, 2013. Sampling was conducted in accordance with SOP-12- Surface Soil Sampling for Asbestos from Basic Remediation Company Standard Operating Procedures BMI Common Areas, Clark County, Nevada.

Each sampling location was the center of a 50 feet by 50 feet sampling grid which was further divided into four quadrant grid squares that were 25 feet on a side. The samples were composites of four component samples with each component collected from within each of the four grid squares of the sampling grid. At each defined location within each grid square a square area that was approximately 1 foot on a side and 1 inch deep was scraped and sealed in a zip-lock bag. Roughly equal portions were obtained from each quadrant, the bag sealed and then mixed. The contents of the plastic bag were place into two 8-ounce containers and sealed tight. These samples were then appropriately labeled and noted on the Chain-of-Custody form and given to the field representative of GEI for shipment to the analyzing laboratory.

The results of the asbestos sampling are tabulated in Table 6-7 and mapped on Figure 6-58. Asbestos presence exceeds the above-mentioned comparison criteria at 4 locations. Three samples from the NSA exceeded the comparison criteria:

- NS-SS-1: long amphibole fibers- 3
- NS-SS-3: long chrysotile fibers- 8
- NS-SS-5: long amphibole fibers- 1

One sample from a drainage ditch exceeded the comparison criteria:

- DD-B-1 (Mystery Ditch): long amphibole fibers- 3

6.2.3.5 Volatile Organic Chemicals

The only known source area at the TIMET Plant which received VOC-containing wastes is the J2 Landfill, in particular the Used Paint and Solvent Area (PSA 16) located within the J2 Landfill.

No VOCs were detected in soil samples above comparison levels (outdoor industrial worker BCL and LBCL DAF 20).

There are three VOCs of interest at the TIMET site. Chloroform has been released to the west and has migrated in groundwater to the TIMET property. Tetrachloroethene and trichloroethene have been detected in site groundwater and may be sourced from the above-mentioned waste disposed in the J2 Landfill.

Chloroform:

Surface Soil (0-6 inches bgs): The distribution of chloroform measured in surficial soil samples (0 -6" bgs) collected during the Supplemental CMS Investigation is mapped on Figure 6-59. Chloroform did not exceed the comparison levels in any sample.

Shallow Soil (0-12 inches bgs): The distribution of chloroform measured in shallow soil samples (0 -12" bgs) collected during the Supplemental CMS Investigation is mapped on Figure 6-60. Chloroform did not exceed the comparison levels in any sample.

Subsurface Soil (>1 foot bgs): The distribution of chloroform in the subsurface soil samples collected for the 2007 CSM Report are presented in Figure 6-61. The distribution of chloroform measured in subsurface soil samples collected during the Supplemental CMS Investigation is mapped on Figure 6-62. Chloroform did not exceed the comparison levels in any sample.

Tetrachloroethene:

Surface Soil (0-6 inches bgs): The distribution of tetrachloroethene measured in surficial soil samples (0 -6" bgs) collected during the Supplemental CMS Investigation is mapped on Figure 6-63. Tetrachloroethene did not exceed the comparison levels in any sample.

Shallow Soil (0-12 inches bgs): The distribution of tetrachloroethene measured in shallow soil samples (0 -12" bgs) collected during the Supplemental CMS Investigation is mapped on Figure 6-64. Tetrachloroethene did not exceed the comparison levels in any sample.

Subsurface Soil (>1 foot bgs): The distribution of tetrachloroethene in the subsurface soil samples collected for the 2007 CSM Report are presented in Figure 6-65. The distribution of tetrachloroethene measured in subsurface soil samples collected during the Supplemental CMS Investigation is mapped on Figure 6-66. Tetrachloroethene did not exceed the comparison levels in any sample.

All of the quantifiable occurrences of tetrachloroethene in subsurface soil are located in and around the J2 Landfill, Ponds Area, and adjacent Near-Surface Soil Areas. The measured tetrachloroethene results above the detection limits (slightly exceeding the detection limit), range from 0.005 to 0.006.5 mg/kg at eight locations. Based on the low frequency of detections, the source of PCE in subsurface soil is difficult to identify. Given the relatively low concentrations of the solute plume (discussed below), it is possible that tetrachloroethene has migrated to groundwater by vapor transport, at which point it partitions into the aqueous phase. This mode of solvent transport has been reported for landfills in alluvial fan environments with intermediate to deep vadose zones.

Trichloroethene:

Surface Soil (0-6 inches bgs): The distribution of trichloroethene measured in surficial soil samples (0 -6" bgs) collected during the Supplemental CMS Investigation is mapped on Figure 6-67. Trichloroethene did not exceed the comparison levels in any sample.

Shallow Soil (0-12 inches bgs): The distribution of trichloroethene measured in shallow soil samples (0 -12" bgs) collected during the Supplemental CMS Investigation is mapped on Figure 6-68. Trichloroethene did not exceed the comparison levels in any sample.

Subsurface Soil (>1 foot bgs): The distribution of trichloroethene in the subsurface soil samples collected for the 2007 CSM Report are presented in Figure 6-69. The distribution of trichloroethene measured in subsurface soil samples collected during the Supplemental CMS Investigation is mapped on Figure 6-70. Trichloroethene did not exceed the comparison levels in any sample.

In subsurface soil, trichloroethene results are similar to the tetrachloroethene results observed—several detections were just above the detection level in the J2 Landfill and Ponds Area, with no clearly defined source areas or vertical profiles suggesting leaching to groundwater. It is possible that vadose zone transport of trichloroethene, similar to that speculated above for tetrachloroethene, may be via vapor transport.

6.2.3.6 Petroleum Hydrocarbons

Sources of petroleum hydrocarbons at the Plant Site included USTs for gasoline, diesel, or fuel oil; hydraulic fluids; melt shop hydraulic oil; and equipment oil and greases. Prior to 1981, an estimated 5,000 gallons (total) spent oil was used as a dust suppressant on plant roadways. Since

1981, all used oil is shipped off site for recycling. All USTs have been removed or closed in-place.

Shallow Soil (0-12 inches bgs): Of the four samples collected in the ditches, one sample (IDN10-01) was detected for motor oil-range organics at 89 mg/kg but below the screening level of 100 mg/kg. The interior and perimeter roadways had several detections of motor oil-range organics, with two samples exceeding the screening level. The maximum concentration occurred in composite sample RI-10-0/0.5CompA at 400 mg/kg.

Subsurface Soil (>1 foot bgs): Since no significant release of TPH has been reported at the Plant Site, subsurface impacts are not expected. Vertical profiling to depth (about 5 feet bgs) indicates TPH impacts are limited to surface soils. Only one detection of the motor oil-range organics was reported (in subsurface soil sample IDN10-01), at a concentration of 54 mg/kg (below the comparable screening level of 100 mg/kg).

6.2.3.7 Semivolatile Organic Chemicals

SVOCs are not known to be associated with any past or present operations at the TIMET Plant. SVOCs were not investigated for the 2007 CSM.

Subsequent to the 2007 CSM, SVOCs were analyzed in samples collected for the Beta/NW Ditch predesign investigation since chlorinated benzene compounds were produced at the OSSM Site and potentially discharged to the Beta Ditch. For the 2013-2014 CSM Supplemental Investigations, a full suite of SVOCs were analyzed in samples from below the HP-1 pond liner and SW-1.

A subclass of SVOCs, polyaromatic hydrocarbons (PAHs) are nearly ubiquitous in industrial/urban settings and are present wherever combustion occurs and surfaces are paved with asphalt. For the 2013-2014 CSM Supplemental Investigations, PAHs were analyzed in surface soil samples obtained throughout the TIMET Plant.

There was only exceedance of the BCL for outdoor industrial worker. It occurs at sample location NE-B-6 where benzo (a) pyrene was measured at 0.68 mg/kg compared to the BCL of 0.23 mg/kg.

6.2.3.8 Pesticides

Pesticides are not related to any Plant Site waste stream or application. Pesticides were considered in the 2007 CSM because of former manufacturing of organochlorine at the OSSM Site located west of TIMET. Wastewater discharges from former operations at the OSSM Site traversed the Northern Storage Area via the Beta Ditch.

Pesticides were not detected in any soil samples above the comparison levels.

6.2.3.9 Polychlorinated Biphenyls

PCB compounds, primarily PCB-209, were inadvertently generated at low concentrations by the magnesium recovery operations at the TIMET Facility.

The 2007 CSM focused on the presence of aroclors potentially associated with transformers at the facility. The 2013-2014 CSM Supplemental Investigation was expanded to include the full list of PCB congeners throughout the site with added focus on areas considered most likely to have received PCB containing material derived from the magnesium recovery operations. These areas include drainage ditches and areas of the NSA traversed by current and former drainageways, Francy's Mountain, the CSD Ponds, HP-1(below the liner), SW-1 (see Section X) and soil adjacent to the J2 Landfill.

The soil comparison level used for screening is 0.83 mg/kg (outdoor industrial worker BCL).

Surface Soil (0-6 inches bgs): The PCB results from the CSM Supplemental Investigations are presented in Table 6-10 and mapped (PCB-209 and total PCBs calculated by the laboratory) on Figure 6-71.

Based on the complete congener analyses, PCBs exceed the BCL in surface soils at the following locations:

- DD-B-1 (Mystery Ditch): Total PCB congeners, 1.6 J mg/kg; PCB-209, 0.25 J mg/kg
- J2-SS-1 (northwest of J2 Landfill): Total PCB congeners, 0.88 J mg/kg; PCB-209, 0.43 J mg/kg
- P-B-11 (CSD Ponds): Total PCB congeners, 1.4 J mg/kg; PCB-209, 0.56 J mg/kg
- P-B-12 (CSD Ponds): Total PCB congeners, 1.4 J mg/kg; PCB-209, 0.51 J mg/kg

Several Beta/NW Ditch samples and Process Area samples were analyzed only for aroclors. Total PCBs based on aroclor analyses exceeded the BCL at one location:

- NW-18 (Beta/NW Ditch): Total PCB aroclors, 0.93 J mg/kg; aroclor 1254, 0.93 J mg/kg

Aroclors were not detected in CSM Supplemental Investigation samples targeted to investigate PCB transformers in the Process Area (samples PA-SS-9, PA-SS-10, and PA-SS-11) as shown on Table 6-10.

Shallow Soil (0-12 inches bgs): As indicated above, the PCB analyses conducted for the 2007 CSM targeted aroclors. The distribution of PCB aroclors in shallow soil samples collected for the 2007 CSM Report is presented in Figure 6-72. For the 2007 CSM, investigation of PCBs in surface soils was conducted in the transformer storage area formerly located at the present site of the WCF, ditches, and at TRECO. The maximum aroclor concentration detected was 2.6 mg/kg. Aroclor concentrations exceeded the BCL of 0.83 mg/kg in two samples from the transformer storage area (samples TS-2 and TS-3) and in one sample from the Alpha Ditch (sample AD-1). Aroclors detected were 1254 and 1260.

The former transformer storage area is capped with the foundation for the WCF (NDEP, by letter dated November 29, 2004, determined no further action was required in this area). The Alpha Ditch was reportedly excavated when the ditch was converted into a piped conveyance.

Subsurface Soil (>1 foot bgs): Aroclor concentrations measured in the subsurface soil samples collected for the 2007 CSM Report are presented on Figure 6-73. Subsurface soil in the vicinity of the transformer storage was investigated as part of the WCF soils investigation. Specifically, JS-02 was reported as nondetect for PCBs in the 4 to 5-foot-bgs sample interval. Confirmation samples were not collected at the base of the excavation in the Alpha Ditch, although the 4 to 5 foot sample interval in sample OWS-01 along the banks of the Alpha Ditch were also nondetect for PCBs. Five sample locations were assessed as part of the TRECO investigation. All samples from the 5- and 10-foot intervals were reported as nondetect for PCBs.

PCB congener concentrations measured in the subsurface soil samples collected for the Supplemental CSM Investigation and Beta/NW Ditch predesign sampling are presented on Figure 6-74. The BCL was exceeded in four Beta Ditch pre-design samples as listed below:

- NW-1 (Beta/NW Ditch, depth 10-11 feet –subsequently excavated as part of Beta Ditch Remediation): Total PCB congeners, 0.883 J mg/kg; PCB-209, 0.452 mg/kg
- NW-2 (Beta/NW Ditch, depth 10-11 feet –subsequently excavated as part of Beta Ditch Remediation): Total PCB congeners, 0.885 J mg/kg; PCB-209, 0.486 mg/kg
- NW-11 (Beta/NW Ditch, depth 10-11 feet –subsequently excavated as part of Beta Ditch Remediation): Total PCB congeners, 0.883 J mg/kg; PCB-209, 0.452 mg/kg
- BD-4 (Beta/NW Ditch, depth 7.5-8 feet—area of the former ditch that was not excavated): Total PCB congeners, 1.06 mg/kg; PCB-209, 0.501 mg/kg

In addition, the BCL was exceeded in four samples collected below the HP-1 liner as listed below

- HP-1-2-1 (HP-1, depth 0-1.0 feet below bottom liner): Total PCB congeners, 0.883 J mg/kg; PCB-209, 0.452 mg/kg

- *Underlying sample at this location (HP-1-2-2), obtained 2.0-2.5 feet below bottom liner is below BCL: Total PCB congeners, 0.0132 J mg/kg; PCB-209, 0.000441 J mg/kg*
- HP-1-3-1 (HP-1, depth 0-1.0 feet below bottom liner): Total PCB congeners, 4.35 J mg/kg; PCB-209, 2.28 mg/kg and HP-1-3-2 (HP-1, depth 1.1-1.5 feet below bottom liner): Total PCB congeners, 20.7 J mg/kg; PCB-209, 12.4 mg/kg
 - *Underlying sample at this location (HP-1-3-3), obtained 2.0-2.5 feet below bottom liner is below BCL: Total PCB congeners, 0.547 J mg/kg; PCB-209, 0.279 J mg/kg*
- HP-1-4-1 (HP-1, depth 0-1.0 feet below bottom liner): Total PCB congeners, 2.55 J mg/kg; PCB-209, 0.0268 mg/kg
 - *Underlying sample at this location (HP-1-4-2), obtained 2.0-2.5 feet below bottom liner is below BCL: Total PCB congeners, 0.0165 J mg/kg; PCB-209, 0.000605 J mg/kg*

All samples from below the HP-1 liner exceeding BCLs were underlain by samples below BCLs. The exceedances are limited to the upper 2 feet below the bottom of the liner.

6.2.3.10 Dioxins and Dibenzofurans

Dioxins and dibenzofurans have no known association with any past or present operations at the TIMET Plant. Dioxins and dibenzofurans were not investigated for the 2007 CSM.

Subsequent to the 2007 CSM, dioxins and dibenzofurans were analyzed in samples collected for the Beta/NW Ditch predesign investigation and the 2013-2014 CSM Supplemental Investigations.

The BCL for outdoor industrial worker exposed to a mixture of dioxins and dibenzofurans expressed as Toxic Equivalency (TEQ) is 0.001 mg/kg.

Beta/NW Ditch exceedances and location dispositions with respected to the 2013 removal action are listed below (Figure 6-75, Figure 6-76):

- NW-2 (excavated), 10-11 feet (0.0105 mg/kg)
- NW-8 (excavated), 5-6 feet (0.00632 mg/kg)
- NW-14 (excavated), 0-0.5 feet (0.00102 mg/kg)
- NW-20 (excavated), 10-11 feet (0.0148 mg/kg)

- BD-2 (not excavated), 17-18 feet (0.00593 mg/kg)
- BD-4 (excavated), 7.5-8 feet (0.0104 mg/kg)
- BD-5 (excavated), 2.5-3 feet (0.00135 mg/kg)
- BD-15 (excavated), 0.5-1.5 feet (0.0022 mg/kg)
- BD-16 (not excavated), 18-19 feet (0.00575 J mg/kg)

One sample exceeded the BCL from the NSA (NS-SS-1, 0-0.5 feet at 0.008 mg/kg).

One sample exceeded the BCL from the Ponds Area (P-B-12 at the CSD Ponds, 18-23 feet at 0.0011 mg/kg).

6.2.4 Chemical Presence in SW-1

Composite samples of the material in SW-1 were obtained as described in Section 6.1. This sampling was performed to obtain information on the chemical composition of the contents of SW-1. Although the composite data are limited with respect to use in risk analysis, results are compared with the BCLs as an indication of the potential risks associated with SW-1.

Results from the sampling of SW-1 are included with the mapped results of the CSM Supplemental Investigations and Beta/NW Ditch predesign investigations presented in the subsurface soil figures referenced in Section 6.2.3. The material present in SW-1 is comprised primarily of the following substances (average of three composite samples):

- Water Content: 45.7%
- Chloride: 20.3%
- Calcium: 11.4%
- Magnesium: 4.3%
- Sodium: 1.5%
- Sulfate: 0.9%
- Aluminum: 0.7%
- Vanadium: 0.7%
- Chromium: 0.3%

- Nitrate: 0.2%
- Potassium: 0.1%

Together, these substances account for 86% of the material contained in SW-1. Chemicals exceeding the BCLs include:

- Nitrate- exceeds LBCL DAF 20, does not exceed BCL for outdoor industrial worker
- Aluminum- exceeds LBCL DAF 20, does not exceed BCL for outdoor industrial worker
- Antimony- exceeds LBCL DAF 20, does not exceed BCL for outdoor industrial worker
- Cobalt- exceeds LBCL DAF 20, does not exceed BCL for outdoor industrial worker
- Iron- exceeds LBCL DAF 20, does not exceed BCL for outdoor industrial worker
- Magnesium- exceeds LBCL DAF 20, does not exceed BCL for outdoor industrial worker
- Manganese- exceeds LBCL DAF 20, does not exceed BCL for outdoor industrial worker
- Nickel- exceeds LBCL DAF 20, does not exceed BCL for outdoor industrial worker
- Vanadium- exceeds LBCL DAF 20, does not exceed BCL for outdoor industrial worker
- Hexachlorobenzene-exceeds both BCLs, maximum concentration 13 mg/kg
- Total PCB Congeners: exceeds BCL for outdoor industrial worker (maximum concentration 1.72 J mg/kg)

Radionuclides exceed BCLs at all three samples. Concentrations are somewhat higher than in site soils but are within the same order of magnitude.

There were no BCL exceedances of dioxins or VOCs in samples from SW-1.

6.2.5 Chemical Presence in First WBZ Groundwater

The distributions of SRCs in First WBZ groundwater are mapped using the results from groundwater samples collected during the second semiannual period of 2012 (October 2012) and the first semiannual period of 2013 (April 2013). These sampling events are the most recent conducted prior to the decommissioning of a number of monitoring wells as part of the Beta Ditch and Northwest Ditches remediation and slurry wall construction projects.

In addition, 2 new monitoring wells were installed as part of the CSM Supplemental Investigation. These wells were sampled in February and April, 2014 and are discussed separately from the mapped distributions.

6.2.5.1 Dissolved Solids

The dominant ions comprising the TDS observed in groundwater at and downgradient of TIMET are sodium, calcium, sulfate and chloride. These four ions make up 86-98% of the total dissolved inorganic chemicals analyzed (based on the October 2012 and April 2013 sampling events).

In September 2009, NDEP released a letter requiring the analysis and evaluation of cation-anion balance (CAB) in groundwater. TIMET has subsequently included evaluation of CAB in its groundwater monitoring reports. This analysis and evaluation was conducted for the data sets discussed herein and is presented in the 2013 Annual Groundwater Monitoring Report (GEI, 2013b).

The total dissolved solids (TDS) concentrations measured in first WBZ groundwater are mapped on Figures 6-77 (October 2012) and 6-78 (April 2013). TDS concentrations are generally lowest in upgradient wells (TMMW wells), and highest near the downgradient (north) boundary of the TIMET property. TDS concentrations remain similarly elevated in the off-site downgradient groundwater where TDS plumes originating from the NERT and OSSM Sites likely comeingle. The greatest TDS concentrations (greater than 10,000 mg/L) were reported in monitoring wells on the downgradient property boundary (TMPZ-107 and TMPZ-108) during both monitoring events; however, comparable TDS concentrations were reported in offsite downgradient monitoring wells PC-067, PC-024, and DBMW-3.

TDS concentrations are generally stable in project area monitoring wells (on and offsite), with the exception of wells TMPZ-108 and CMT-101, which exhibit decreasing trends (see reference report

The sodium, calcium, sulfate and chloride plumes individually mimic the TDS plume. Together these four ions account for more than 90% of the measured TDS.

Nitrate in groundwater exceeds the BCL of 10 mg/L in most monitoring wells. Even nitrate concentrations in TMMW-103 (on Lake Mead Boulevard) and BRW-R1 (upgradient of suspected nitrate source areas) slightly exceed (12 and 14 mg/L, respectively) the BCL. Groundwater concentrations downgradient of the Plant Site exceed those on the Plant Site.

6.2.5.2 Metals

Arsenic:

Arsenic was reported at concentrations above the comparison level (10 µg/L) in every well sampled during both of the monitoring events (Figures 6-79 and 6-80). Wells located along the western property boundary exhibit the greatest arsenic concentrations (as high as 400 µg/L in CLD4-R during the First Semester 2013 sampling event) with concentrations decreasing to the east and south. Arsenic concentrations are relatively stable in upgradient, Plant Site, and offsite downgradient monitoring wells, with the exception of Plant Site wells CLD4-R and TMPZ-105, which exhibit decreasing trends, and downgradient offsite wells PC-067 and PC-028, which exhibit increasing trends (GEI 2013b).

Chromium:

Chromium was reported at concentrations above the comparison level (100 µg/L) in wells located in the northwestern portion of the Plant Site during both of the latest sampling events (Figures 6-81 and 6-82). The chromium observed in groundwater is primarily comprised of hexavalent chromium, which also has a comparison level of 100 µg/L (Figures 6-83 and 6-84).

Consistent with migration from sources at the NERT site, total chromium and hexavalent chromium concentrations are the greatest at the northwestern corner of the TIMET property and northwest of the site. The greatest chromium and hexavalent chromium concentrations reported during the latest monitoring period are 1,300 µg/L (PC-054, both sampling events) and 1,200 µg/L (CLD1-R, Second Semester 2012 sampling event), respectively. Total chromium concentrations appear to be relatively stable in each of the project monitoring wells (i.e., upgradient, Plant Site, and downgradient), with the exception of Plant Site Wells CMT-101, J2U2, and CLD1-R, which exhibit increasing trends, and offsite downgradient wells PC-054, PC-028, and PC-067, which exhibit decreasing trends (GEI, 2013b).

Uranium:

Uranium was reported at concentrations above the comparison level (30 µg/L) in most wells located in the north half of the Plant Site, as well as offsite to the north, during the latest sampling events (Figures 6-85 and 6-86). The Plant Site wells with the greatest uranium concentrations were TMPZ-110 (120 µg/L during the Second Semester 2012 event) and J2U2 (120 µg/L during the First Semester 2013 event). PC-067 was the offsite well with the greatest uranium concentrations during both sampling events (130 µg/L during the Second Semester 2012 sampling event and 150 µg/L during the First Semester 2013 sampling event). Uranium concentrations are relatively stable, except for downgradient well PC-054 which exhibits a decreasing trend (GEI 2013b)

Manganese:

The highest manganese concentrations during the latest monitoring period were reported in CLD4-R, which is located on the western property boundary. Manganese was reported in CLD4-R at concentrations of 2,900 µg/L and 950 µg/L during the Second Semester 2012 sampling event and the First Semester 2013 sampling event, respectively (Figures 8-87 and 6-88). The comparison level for manganese is 50 µg/L.

Manganese concentrations are generally stable in most wells, with the exception of TMMW-101 (upgradient, offsite) and PC-054 (downgradient, offsite) which exhibit decreasing trends and CLD4-R (Plant Site) and PC-067 (downgradient, offsite), which exhibit increasing trends (GEI 2013b). The comparison level for manganese is a secondary MCL. Secondary MCLs are based on cosmetic/aesthetic effects, not necessarily health-based effects.

Vanadium:

During the latest two (2) monitoring events, vanadium was reported at concentrations of 1,400 µg/L (Second Semester 2012) and 14,000 µg/L (First Semester 2013) in monitoring well CLD4-R (Figures 6-89 and 6-90). Both results are significantly greater than vanadium concentrations reported in the other project area wells, which ranged from 10 µg/L (TMMW-103, Second Semester 2012) to 220 µg/L (TMPZ-106, Second Semester 2012). The comparison level for vanadium is 182.5 µg/L. The results of historic groundwater monitoring activities have shown significant fluctuations in CLD4-R vanadium concentrations, while vanadium concentrations in other site wells are considerably lower and more stable (GEI, 2013b). Based on the vanadium data collected to date, it appears that the elevated/unstable vanadium concentrations are isolated to CLD4-R.

Lithium:

Lithium was reported at concentrations above the comparison level of 73 µg/L in each well sampled during the latest monitoring period, with the exception of upgradient wells TMMW-102 and TMMW-104 during the Second Semester 2012 sampling event, where lithium was reported at concentrations of 63 µg/L and 66 µg/L, respectively (Figures 6-91 and 6-92). Lithium concentrations show significant variations between the Second Semester 2012 sampling event and the First Semester 2013 sampling event.

During the Second Semester 2012 sampling event, the greatest lithium concentration (770 µg/L) was reported in monitoring well CLD4-R, on the western property boundary and during the First Semester 2013 sampling event, the greatest lithium concentration (740 µg/L) was reported in monitoring well TMPZ-107, on the northern property boundary.

With the exception of the First Semester 2013 sampling results, lithium concentrations are generally decreasing in upgradient, Plant Site, and downgradient wells. However, the First

Semester 2013 sampling results appear to be greater than historic results in upgradient, Plant Site, and downgradient monitoring wells (GEI, 2013b).

Radionuclides:

Radionuclides reported at concentrations above the comparison levels during the latest monitoring period include thorium-228, 230, and 232; gross alpha; gross beta; and radon-222. The comparison levels for the aforementioned constituents are 0.110 pCi/L, 0.042 pCi/L, 0.140 pCi/L, 15 pCi/L, 50 pCi/L, and 300 pCi/L (proposed), respectively.

None of the above referenced radionuclides are pervasively present at concentrations above the comparison levels in groundwater on and around the subject property, with the exception of radon-222. Radon-222 was reported at concentrations above the comparison level of 300 pCi/L throughout the BMI Complex and the TIMET Plant Site during both sampling events of this monitoring period.

As shown on Figures 6-93 and 6-94, radon-222 concentrations are generally lowest in upgradient wells (albeit still above the comparison level of 300 pCi/L), and increase downgradient to the center of the site and the northern site boundary, with the greatest radon-222 concentrations reported in Plant Site well TMPZ-107 (3,230 pCi/L during the Second Semester 2012 and 3,200 pCi/L during the First Semester 2013) on the northern site boundary.

The radon-222 concentrations reported during this monitoring period are generally consistent with historic radon-222 results. Radon-222 concentrations generally range from 200 pCi/L to 1,000 pCi/L in offsite upgradient wells and less than 500 pCi/L to greater than 3,000 pCi/L in Plant Site wells. In general, radon concentrations are stable, with the exception of the upgradient wells (TMMW wells) and Plant Site well TMPZ-109 which exhibit slight increasing trends, and Plant Site wells TMPZ-108, J2D3, and TMPZ-112 which exhibit decreasing trends (GEI 2013b).

6.2.5.3 Volatile Organic Chemicals

VOCs reported at concentrations above the respective comparison levels in groundwater during the latest monitoring period include tetrachloroethene (PCE); trichloroethene (TCE); total trihalomethanes (TTHM); carbon tetrachloride; 1,1-dichloroethene; and 1,2-dichloropropane. For 1,1-dichloroethene, 1,2-dichloropropane and carbon tetrachloride only minimal and or sporadic/anomalous/offsite exceedances of the comparison levels have been reported (GEI, 2013b).

The distribution of PCE is depicted on Figures 6-95 and 6-96. As shown in the aforementioned figures, the highest PCE concentrations during the latest monitoring period were reported in monitoring wells AA-01 (72 µg/L, Second Semester 2012) and TMPZ-111 (65 µg/L, First Semester 2013). Elevated PCE concentrations were also reported in site monitoring well J2D2-

R2 during both of the latest monitoring events (68 µg/L, Second Semester 2012 and 62 µg/L, First Semester 2013). The comparison level for PCE is 5 µg/L.

The downgradient extent of the PCE plume occurs as defined by PCE concentrations less than 5 µg/L reported in monitoring wells DBMW-1, DBMW-3, DBMW-4, and DBMW-5. PCE concentrations in upgradient, Plant Site, and downgradient monitoring wells are generally stable or decreasing, with decreasing trends apparent for Plant Site wells J2D4, J2D2-R2, J2U2, J2D1-R2, and TMPZ-108, and downgradient offsite wells AA-01 and PC-067 (GEI, 2013b).

TCE was reported at concentrations above the comparison level of 5 µg/L in the following wells during the latest monitoring period: J2D2-R2, J2D4, J2U2, TIMETMW-3R, TIMETMW-1, and TMPZ-109. The greatest TCE concentration reported during the latest monitoring period was 19 µg/L in well TIMETMW-3R during the Second Semester 2012 sampling event. The TCE plume appears to be localized to the southern and central portions of the site with general decreasing concentration trends (GEI, 2013b).

As depicted on Figures 6-97 and 6-98, TTHMs (which can be considered consisting entirely of chloroform) are prevalent at concentrations above the comparison level of 80 µg/L throughout the northwestern portion of the Plant Site, as well as offsite to the north (downgradient). The greatest TTHM concentrations (1,403.18 µg/L, Second Semester 2012 and 1,102.23 µg/L, First Semester 2013) were reported in monitoring well TMPZ-107 during both of the latest sampling events; however, significant concentrations of TTHMs (i.e., several hundred µg/L) were reported in wells along the western property boundary (M-129, M-130, CLD4-R), consistent with migration of chloroform onto TIMET property from the NERT site. TTHM concentrations in groundwater appear to be relatively stable in offsite (upgradient and downgradient) wells and Plant Site wells, except for Plant Site wells J2U2, CLD4-R, and TMPZ-107 which exhibit decreasing trends (GEI, 2013b).

6.2.5.4 Perchlorate

During the latest monitoring period, reported perchlorate concentrations ranged from 0.027 mg/L (TMMW-104, First Semester 2013) to 350 mg/L (PC-028, Second Semester 2012). The greatest perchlorate concentrations (approximately 200 mg/L to 300 mg/L) were reported in downgradient offsite wells PC-054 and PC-028 and the lowest perchlorate concentrations (0.06 mg/L or less) were reported in upgradient offsite wells TMMW-102 and TMMW-104 (Figures 6-99 and 6-100). Perchlorate concentrations in Plant Site wells ranged from 0.13 mg/L (TIMETMW-4, Second Semester 2012) to 81 mg/L (M-129, First Semester 2013). Consistent with migration from sources at the NERT site, perchlorate concentrations are the greatest at the northwestern corner of the TIMET property and northwest of the site. The comparison level for perchlorate is 0.018 mg/L.

6.2.5.5 Sampling of Additional Wells Installed for CSM Supplemental Investigation

Monitoring wells CSMMW-1 and CSMMW-2 installed in accordance with the CSM Supplemental Investigation Work Plan were sampled on February 27, 2014 and April 10, 2014.

Chloroform was reported at concentrations between 10 ug/l (CSMMW-1; February 27, 2014) and 30 ug/l (CSMMW-2; February 27, 2014). The BCL for chloroform is 0.19 ug/l. Perchlorate was reported at concentrations between 340 ug/l (CSMMW-2; April 10, 2014) and 580 ug/l (CSMMW-1; April 10, 2014). The BCL for perchlorate is 18 ug/l. Arsenic was reported at concentrations between 31 ug/l (CSMMW-1; February 27, 2014) and 140 ug/l (CSMMW-2; April 10, 2014). The BCL for arsenic is 10 ug/l.

The groundwater sampling results are summarized in Table 6-12.

6.2.6 Vertical Delineation Assessment

A Vertical Delineation Assessment was conducted by TIMET in 2008. Results are presented in the report titled "Task I, II and III Data Transmittal Report, Titanium Metals Corporation, Henderson, Nevada" (TIMET 2008a).

Wells used in the Vertical Delineation Assessment are shown on Figure 6-101. Conclusions from this study are summarized below:

- The entire section of MCf explored (including the transitional MCf) is saturated. As a result, transport mechanisms in these units (and the saturated Qal) are not influenced by zones of partial saturation.
- The vertical hydraulic gradient is generally upward from the UMCf to the Qal.
- TDS concentrations in vertical profile for a variety of cross-sections are shown on Figures 6-102 through 6-105. High TDS concentrations were measured in the upper, less fine grained portion of the MCf, which includes the transitional MCf. TDS concentrations as high as 23,000 mg/L were measured 40 feet below the Qal contact (TMSB-132)
- Significant solute plumes of perchlorate (Figures 6-106 through 6-109) and chloroform (Figures 6-110 through 6-113) exist in water bearing zones throughout the lithologic sequence investigated, and appear to have migrated horizontally to TIMET from the NERT site located to the west. Detectable perchlorate and chloroform are virtually ubiquitous in the water-bearing zones explored beneath the plant site.

- The potentially TIMET related VOCs (tetrachloroethene and trichloroethene) are not present above BCLs at depths greater than 5 feet below the Qal contact (Figures 6-114 through 6-121).
- Boring TMSB-133 and corresponding CMT wells CMT-302 through -307 indicate that the VOCs (again, predominantly chloroform) occur in the aqueous phase and no indication of dense, non-aqueous phase liquid (DNAPL) was observed.

6.3 Data Sufficiency

The groundwater data described in this CSM has been sufficient for development of the on-site groundwater remediation program which has been operating since March 12, 2014. Additional data is necessary to assess remedial system performance and downgradient natural attenuation. Work Plans for these monitoring programs have been submitted to and approved by NDEP.

The soils data presented in this CSM are sufficient for qualitative assessment of exposure pathways. Surface and subsurface soil samples have been obtained from all areas of the Site, with a focus on collecting samples at and near PSAs identified as potentially being significant (Section 4.5). A rigorous assessment to determine if the data are sufficient for quantitative risk analysis has not been performed. Such an assessment is recommended should these data be used for quantitative risk assessment in the future. As discussed in Section 6.2.1, all validated data points would be appropriate for use in risk assessment with the appended qualifiers noted in Attachment 6.

The qualitative exposure assessment presented in Section 7.0 identified potentially complete exposure pathways for on-site workers. The data presented in this CSM are sufficient to develop remedial actions to eliminate potentially complete exposure pathways. Quantitative risk assessment is not appropriate.

7. Conceptual Site Model

The purpose of the CSM is to describe the Site and to identify and assess potential sources of chemical release to the environment, transport pathways, exposure routes and receptors. The Site has been described in detail in Sections 2.0 through 6.0. This Section presents an evaluation of the potential sources of chemical release to the environment, associated transport pathways, exposure routes and potential receptors.

7.1 Potential Exposure Pathways

Exposure pathways are the means by which a receptor may come into contact with chemicals released to the environment. An exposure pathway is considered “complete” only if the following four elements (EPA 1989) are present:

- A source and mechanism of Site-derived chemical release to the environment
- An environmental receiving or transport medium (such as air or soil) for the released Site-derived chemical
- A point of potential contact with the medium of concern
- An exposure route (such as ingestion) at the contact point.

Only complete exposure pathways need be evaluated. This section presents an Exposure Pathway Assessment for each source area on the TIMET site based on information obtained through the document reviews and site investigations summarized in Sections 2.0 through 6.0.

As described in Section 6.0, TIMET-related chemical presence in environmental media at the site has been measured in:

- Soil, surficial and subsurface
- Groundwater
- Waste material, including landfilled material and the contents of SW-1

In general, the potential pathways through which receptors may become exposed to chemicals present in these media include:

- Direct contact with site soils or waste

- Exposure (direct contact or inhalation) to chemicals present in fugitive dust being eroded from the site
- Exposure to stormwater that has come into contact with chemicals present in site soils or waste
- Exposure to chemicals which have leached from soils and migrated to the groundwater. Exposure could occur via:
 - Inhalation of chemicals that have vaporized from the groundwater and enter occupied structures (vapor intrusion)
 - Direct contact and ingestion (potable use of impacted groundwater)
 - Exposure (direct contact or ingestion) to surface waters which have been impacted by groundwater discharge.

7.2 Chemical Transport Considerations

There are four modes by which chemicals released on site can be transported to the off-site environment:

1. Airborne transport (of dust or volatilized chemicals)
2. Water erosion of impacted soil and waterborne transport in runoff
3. Leaching of chemicals to groundwater and transport with groundwater flow
4. Mechanical transport via mobile equipment (e.g., drag-out)

7.2.1 Airborne Transport

Airborne transport is considered in the assessment of exposure pathways presented herein.

7.2.2 Transport in Surface Water

The potential impacts of waterborne erosion (if any) would have contributed to the BMI Common Areas and are not evaluated herein (other than to acknowledge this process may have occurred). However, waterborne transport is considered with respect to on-site remediation which is (will be) intended to prevent future transport via water erosion (Section 8.0).

7.2.3 Transport in Groundwater

Regarding migration to and within groundwater, the major groundwater impact at TIMET is TDS. It is unlikely the TDS levels measured in groundwater have been caused by leaching from

soils. Concentrations of the major solids measured in groundwater in soil are not high enough to have resulted in the observed groundwater TDS concentrations which have been relatively stable in excess of 10,000 mg/l for the entire timeframe of groundwater monitoring (more than 20 years). Furthermore, the vertical distribution of TDS, at least at some locations, show higher concentrations of TDS in the upper portion of the MCf, which is difficult to explain by leaching from soils.

The more reasonable explanation for the elevated and persistent TDS concentrations in the First WBZ is that the dissolved solids were primarily released from historic unlined ponds at the BMI Complex. TDS concentrates rather quickly in the ponds due to evaporation and a high density aqueous phase liquid develops. The dense salt-laden water likely seeped into soil and over time may have created a continuous saturated zone below the pond, at which point the hydraulic gradient and density difference would have driven TDS into the UMCf, despite its low hydraulic conductivity relative to the Qal. This would have created a “sink” for TDS in the UMCf. Horizontal flow of the dense aqueous phase would also have occurred in the Qal, accounting for the downgradient off-site TDS concentrations.

Unlined ponds have not been used at the TIMET Facility for more than 20 years. Hydraulic gradients from the UMCf to the Qal have resumed the natural upward direction (Section 2.3). Under current conditions, the TDS present in the UMCf is migrating upward to the Qal and may account for the lack of TDS concentration decline which may have otherwise been anticipated to occur in the Qal after lining of the site ponds.

This condition has implications for the groundwater transport pathway in that interception of horizontal flow in the Qal would also intercept the on-site upward (TDS containing) flow from the UMCf to the Qal and could effectively cutoff off-site migration of TIMET derived chemicals in groundwater.

7.2.4 Volatilization from Groundwater

Volatile chemicals, if present in migrating groundwater, can vaporize and migrate through soils into occupied structures. A vapor intrusion study was undertaken by all participating parties in the BMI Complex (Basis Remediation Company, Olin Chemicals, Stauffer Management Company, Montrose Chemical Corporation of California and TIMET). These results are presented in the following report: “Potential Vapor Intrusion Pathway Evaluation Integrated Summary Report BMI Complex and Common Areas Projects, Henderson, Nevada, Revision 1.0”, (Hargis + Associates, Inc., 2009).

This evaluation did not identify any significant potential for vapor intrusion of TIMET-related VOCs (tetrachloroethene and trichloroethene). Therefore, off-site vapor intrusion is not considered a complete pathway in this CSM.

7.3 Exposure Considerations

The anticipated use of the TIMET site is expected to remain commercial/industrial. It is the only titanium-processing plant in North America and provides economic benefits for its owners, shareholders, and the local economy. Therefore, most human receptors exposed to Site-derived chemicals on the property are expected to be commercial/industrial workers. Residential land use, which is the most restrictive option for protection of human health, is not currently under consideration for the property. However, residential developments exist within approximately 500 feet north of the TIMET property and are proposed on undeveloped properties also to the north of the site. These residential and currently undeveloped properties north of the TIMET site are also downgradient from groundwater and surface water flow (i.e., stormwater runoff). Residences adjacent to the east side of the facility occur within 500 feet of TIMET operations but are not downgradient (with respect to topography or groundwater flow). Therefore, exposures to Site-derived chemicals associated with the TIMET site may be possible for off-site residents to the north (by nature of their downgradient position) but are not likely to the east.

No permitted residential wells exist in the area. Residents rely upon the municipal water supply serviced by the City of Henderson. Direct contact and ingestion exposures to groundwater are not complete pathways. Unauthorized, unpermitted wells are not known or likely to exist. Residential homes are part of planned developments which are supplied with potable water from municipal sources. Residential groundwater wells and exposures from future hypothetical uses of impacted groundwater such as gardening and consumption of homegrown produce are considered to be incomplete for the purposes of this evaluation.

Inhalation of chemicals bound to airborne soil particulates or that volatilize from soil are not considered relevant pathways due to the distance of the residences from the TIMET property and likely dilution in air.

Groundwater downgradient of the site is collected and treated at two interceptor well fields operated by NERT to remove perchlorate and hexavalent chromium from groundwater. Pathways associated with these operations are not considered relevant due to proper safety measures employed by site operations.

7.4 Conceptual Site Model for Each Source Area

7.4.1 *Surface Ditches and Northern Storage Area (Source Area 1)*

Impacts to surface and subsurface soil and groundwater in Source Area 1 are associated with waste streams and historic disposal methods. The NSA was used for storage of solids from CSD ponds and the caustic ponds, refractory brick, construction equipment, concrete, magnesium chloride ingots, reactor lids, asbestos, and coke. The area contained inactive drainage segments and the former BMI pond. The former drainage ditches include the Alpha Ditch, Beta Ditch,

Western Ditch, Northwestern Ditch, Mystery Ditch, former BMI pond, and various inactive site ditches.

Stormwater generated on Source Area 1 is contained on-site in surface ditches and depressions constructed to keep stormwater on the TIMET site. Stormwater generated on Source Area 1 would pool in these on-site surface features and either evaporate or percolate into the subsurface. Information collected during site investigations indicates that commercial/industrial workers conduct activities infrequently, if at all, in this area of the TIMET property, and that durations of visits to this area are short when they occur. A possible exception are environmental contractors that enter the area periodically to collect groundwater samples from existing wells in the area or to conduct other environmental investigations. However, these contractors are protected with appropriate personal protective equipment and special training appropriate for the waste streams they encounter.

A large portion of Source Area 1, including the Beta and Northwest Ditch and NSA debris pile, have been remediated by excavation and off-site disposal. The soils excavated during the Beta/NW Ditch remediation (see Section 5.2) removed the majority of soils with chemicals present above BCLs. Asbestos was measured in 3 samples from the NSA at locations that were not excavated at fiber counts above screening levels. PCBs were detected at 2 locations that were not excavated (one surface sample and one subsurface sample) at concentrations marginally above the BCL of 0.83 mg/kg (maximum detected concentration 1.06 mg/kg). Dioxins (TEQ) were detected above the BCL at one unexcavated surface soil location and two deep soil samples (greater than 17 feet deep) from beneath the extent of the Beta/NW Ditch excavation. VOCs were not detected above BCLs in any soil samples. Arsenic and radionuclides are present above BCLs though are not substantially elevated above background.

Groundwater beneath Source Area 1, as in other areas of the Site, has been primarily impacted by dissolved solids, most notably sodium, calcium, chloride and sulfate. Based on the concentrations measured relative to the LBCL DAF 20 values, soils in Source Area 1 are not a source of organic chemical leaching to groundwater.

For dissolved solids and some metals including manganese, the LBCL DAF 20 values are exceeded across the entire site including upgradient locations, suggesting background levels are above the DAF 20 value.

Figure 7-1 presents the CSM for Source Area 1. It identifies potential exposure pathways for media impacted by this source area. Potentially complete exposure pathways include:

- Exposures for on-site outdoor workers and trespassers (ingestion, dermal and inhalation exposures)

No other pathways are complete for this source area.

7.4.2 Near-Surface Soil Areas (Source Area 2)

Near-Surface Soil Areas are described in Section 4.5.2. The PSAs associated with the Near-Surface Soil Source Area are areas where solid waste and process wastewater were historically stored or discharged. Impacts to environmental media in this source area originate from primary contact with surface soil or settlement and sedimentation from wastewater discharge.

PSAs where solid wastes or materials are or were disposed of, spilled, or stored include Francy's Mountain, S-17 Landfill, Boneyard, Building K-53, Chemtec Corporation Site, and Drum Storage Areas.

Solid waste associated with Francy's Mountain has been removed and the upper 32 inches of underlying soil has been excavated and disposed off-site.

Chemical concentrations are relatively low in the Near-Surface Soils Areas, though a number of results for inorganic parameters exceed the LBCL DAF 20 values. Chemicals were not detected above BCLs in the samples from the Building K-53 Area. Chemicals were not detected above BCLs in the samples from the Building K-55 Area.

PCB congeners and dioxin (TEQ), VOCs, SVOCs and asbestos did not exceed BCLs in any soil samples collected from Source Area 2. Arsenic and radionuclides are present above BCLs though are not substantially elevated above background.

Stormwater generated on this source area generally is not capable of leaving the site. However, some portion of stormwater generated on this source area is expected to pool in on-site surface features, including ditches, and either evaporate or percolate into the subsurface. Based on the concentrations measured relative to the LBCL DAF 20 values, soils in Source Area 2 are not a source of organic chemical leaching to groundwater.

Figure 7-2 presents the CSM for Source Area 2. It identifies potential exposure pathways for media impacted by this source area. Potentially complete exposure pathways include:

- Exposures for on-site outdoor workers and trespassers (ingestion, dermal and inhalation exposures)

No other pathways a complete for this source area.

7.4.3 Pond Areas (Source Area 3)

Pond Areas are described in Section 4.5.3. The principal waste streams associated with the Pond Areas include inorganic process materials and wastes, including CSD solids (PSA 2, 5, 8, and 10), OPW (PSA 2, 5, and 10), leach liquor (PSA 5, 6, 7, and 10), spent caustic (PSA 7, 8, and 10), WCF brine (PSA 6 and 7), NCCW (PSA 10), and magnesium wastes (PSA 27). None of these principal waste streams are associated with VOCs or other organic compounds, however,

PCB congeners were measured above BCLs in samples obtained beneath the HP-1 bottom liner and hexachlorobenzene was detected above BCLs in the contents of SW-1. For HP-1, total PCB congeners did not exceed 50 mg/kg in any sample (maximum concentration of 20.7 mg/kg). In all instances where the BCL for PCBs was exceeded the underlying sample was below the BCL.

The historic unlined ponds are now covered by ponds with engineered liner systems preventing migration to groundwater except for SW-1, which contains a liner but the liner is believed to be compromised and the former BMI Tailings Pond. The BMI J-9 Tailings Ponds received magnesium-manufacturing wastes. Part of the J-9 Tailings Pond was removed to make room for the WCF.

Stormwater generated on this source area is not capable of leaving the site. However, some portion of stormwater generated on this source area is expected to pool in on-site surface features, including ditches, and either evaporate or percolate into the subsurface.

Information collected during site investigations, indicates that commercial/industrial workers conduct activities infrequently in this area of the TIMET property, and that durations of visits to this area are short when they occur.

Figure 7-3 presents the CSM for Source Area 3. It identifies potential exposure pathways for media impacted by this source area. Potentially complete exposure pathways include:

- Exposures for on-site outdoor workers and trespassers (ingestion, dermal and inhalation exposures)

7.4.4 J2 Landfill Area (Source Area 4)

The J2 Landfill Area is described in Section 4.5.4. Two of the four PSAs associated with the J2 Landfill are areas where solid wastes are currently and/or were historically stored or discharged. As such, impacts to environmental media in this source area originate from primary contact with surface soil. PSAs where solid wastes or materials are or were disposed of, spilled, or stored include J2/S-18 Landfill (PSA 30) and Rubble and Debris (PSA 33). Solid wastes associated with these two areas were considered nonhazardous. The J2/S-18 Landfill previously operated as a “cut and fill” landfill. A new cell in the J2 Landfill on the northern end of the PSA is lined.

The Used Paints and Solvent Area (PSA 16), formerly used to store used paint and solvent from the Facility’s paint shop, is the only PSA known to be associated with VOCs. The TCE and PCE groundwater plumes are suspected to originate from this source area.

Information collected during site investigations, indicates that commercial/industrial workers conduct activities infrequently in this area of the TIMET property, and that durations of visits to this area are short when they occur. TCE and PCE have been detected in monitoring well J2U2 located within 100 feet of Building J-2 and several buildings east of Building J-2.

Figure 7-4 presents the CSM for Source Area 4. It identifies potential exposure pathways for media impacted by this source area. Potentially complete exposure pathways include:

- Exposures for on-site outdoor workers and trespassers (ingestion, dermal and inhalation exposures)
- Exposures for on-site commercial workers via vapor intrusion in buildings located close to well J2U2

7.4.5 Current and Historical Operational Areas (Source Area 5)

The Current and Historical Operational Areas are described in Section 4.5.5.

This source area includes the Pioche Manganese Landfill S-20 (PSA 4), the Rutile Off-Loading Area (PSA 13), and the Material and Equipment Storage Area East of Building J2 (PSA 15). In general, BCLs for outdoor industrial worker were not exceeded in Source Area 5 (with the exceptions of arsenic and radionuclides which are not substantially elevated above background).

Stormwater generated on this source area is not believed to be capable of leaving the site. However, some portion of stormwater generated on this source area is expected to pool in on-site surface features, including ditches, and either evaporate or percolate into the subsurface.

This source area is generally upgradient to the likely source of the TCE and PCE plumes (J2 Landfill Area) relative to groundwater flow. However, TCE and PCE have been detected in monitoring well J2U2 located near (approximately crossgradient to) PSA 15 (Material and Equipment Storage Area East of Building J2). Therefore, subsurface vapor migration is of potential note in this source area because of the distance from buildings on PSA 15 to the edge of the plume.

Figure 7-5 presents the CSM for Source Area 5. It identifies potential exposure pathways for media impacted by this source area. Potentially complete exposure pathways include:

- Exposures for on-site outdoor workers and trespassers (ingestion, dermal and inhalation exposures)

7.5 Summary of Potentially Complete Human Exposure Pathways

Potentially complete exposure pathways potentially exist for three human receptor groups for the TIMET site (current and future commercial/industrial workers, trespassers, and future construction workers). Each of these receptors is detailed in Section 5.5.

The environmental media or pathways by which each receptor group might be exposed to Site-derived chemicals associated with the TIMET site are described in the following sections.

Figures 7-1 through 7-5 conceptualize the site releases and ultimate exposures to potential receptors.

7.5.1 Outdoor Air

Site-derived chemicals present in site soils and groundwater are potentially may be transported in outdoor as a result of volatilization from soil or groundwater (VOCs, including radon, only) or wind erosion of particulates (fugitive dust). Chemicals transported from on-site soil gas or fugitive dust present in wind leaving the site would be expected to dilute in air rapidly and would not affect the off-site environment. Therefore, inhalation exposures via this route are only considered potentially complete for on-site exposures.

7.5.2 Indoor Air

The indoor air pathway(s) is only relevant for areas improved with structures, such as homes or commercial developments, and overlie subsurface soils and/or groundwater impacted with VOCs. In such cases, VOCs can migrate vertically in soil gas through the soil profile and through building foundations or basements into indoor air space. Volatile chemicals can also volatilize into indoor air during use of impacted groundwater. The only VOCs associated with the TIMET facility that have the potential to migrate into indoor air are tetrachloroethene and trichloroethene. Chloroform, present on the TIMET property due to migration from off-site sources is also a potential concern with respect to vapor intrusion. Indoor air pathways are only relevant in areas with structures over the tetrachloroethene, trichloroethene and chloroform groundwater plumes.

The off-site vapor intrusion pathway was found to be incomplete for the TIMET-related VOCs (Hargis + Associates, 2009).

7.5.3 Direct Contact with Soil (Dermal and Ingestion)

For purposes of the CSM evaluation, shallow soil is considered soil between 0 and 0.5 foot from the ground surface. Direct exposures to chemicals present in shallow soil are possible through skin contact with and ingestion of soil particles.

For purposes of the CSM evaluation, subsurface soil is considered soil between 1 and 10 feet bgs. It is not likely that direct exposure to subsurface soil by human receptors associated with the TIMET facility would occur, other than by construction workers involved in excavation activities.

7.6 Summary of Potentially Complete Ecological Exposure Pathways

No complete ecological pathways were identified in this CSM. Ecological receptors are not likely present on-Site given that the TIMET source areas do not present attractive habitat for ecological species. Chemicals associated with the TIMET site are present in groundwater plumes that could potentially migrate to, and discharge into, the Las Vegas Wash, an effluent-dependent surface water feature augmented by large municipal and industrial discharges, located approximately 2.8 miles north of the TIMET site. The only TIMET-related chemicals sufficiently widespread, concentrated and conservative (relatively stable and non-degradable) such that there is a significant potential to reach the Wash are dissolved solids. Currently groundwater which would otherwise discharge to the Wash is intercepted by the NERT downgradient groundwater extraction well fields (the Athens Road well Field and the Seep Well Field) and discharged (under permit issued by NDEP) to the Wash without treatment for dissolved solids. Under these circumstances, it would be irrelevant to assess potential ecological impacts to the Wash for a theoretical scenario where the TIMET-derived TDS discharges to the Wash along a seepage face rather than at the NERT discharge pipe.

8. RAO and TIMET Site Remediation

8.1 RAO

The RAOs for the TIMET site are to eliminate the pathways found to be potentially complete in Section 7.0. The potentially complete exposure pathways are:

1. On-site dermal and ingestion exposures to impacted soil where BCLs are exceeded (site workers and trespassers)
2. On-site inhalation of fugitive dust (site workers and trespassers)
3. On-site inhalation exposure via vapor intrusion into Facility buildings

Identification of a potentially complete exposure pathway does not imply the pathway actually causes a significant risk.

The RAO for the site is to eliminate the potentially complete exposure pathway if it poses significant risk.

8.2 TIMET Site Remediation

For some areas of the Facility, TIMET has eliminated potential exposure pathways 1 and 2 (above) through removal actions and installation of cover systems over the impacted areas of the site. The cover system will eliminate direct contact exposure to potentially impacted site soils. As indicated in Section 5.0, a groundwater remediation system has been installed as directed by NDEP. Soil and groundwater remediation programs undertaken and underway at the TIMET Site are described in Section 5.0.

Regarding pathway 3 (on-site exposure via vapor intrusion), given the relatively low levels of Site-derived VOCs in groundwater near site buildings, the depth to groundwater, the lack of occupied structures over groundwater impacted by VOCs, and the highly ventilated nature buildings located near the fringes of the VOC plume, significant exposure via vapor intrusion is unlikely and mitigation measures are unlikely to be warranted. This may be an issue for further discussion with NDEP.

8.2.1 Soil Remediation

The soil removal actions have eliminated a large amount of potential source material and will lessen the potential for future on-site exposures. The north site cover scheduled for completion during the summer of 2014, in conjunction with new (lined) ponds and the eventual J-2 Landfill cover will eliminate the direct contact and inhalation pathways (fugitive dust emissions) over

areas of the TIMET property with soil concentrations above BCLs except for SW-1 and the CSD Ponds.

TIMET plans to address the CSD ponds by removing any remaining visibly impacted material from the ponds and reconstructing the ponds with liner systems. This will eliminate exposure pathways associated with this area.

Together, the removal actions, north site cover, J-2 cover and pond construction/reconstruction will eliminate direct contact and inhalation exposures associated with the following PSAs:

- NSA (PSA 1)
- Beta/NW Ditch (PSA 11)
- Mystery Ditch and other former ditches (PSA 11)
- Francy's Mountain (PSA 3)
- Low-Lying Area Adjacent to East Side of HP-6 (PSA 9)
- Subsurface Piping (PSA 10)
- Alpha Ditch (PSA 12), Back Ditch (PSA 21)
- Boneyard (PSA 22)
- CSD Ponds (PSA 2), HP-1 (PSA 6), HP-6 (PSA 7)
- BMI J-9 Tailings Ponds (PSA 27)
- J-2 Landfill (PSAs 16, 30, 33)

8.3 Groundwater Remediation

Although there are no completed pathways resulting in off-site or on-site exposure to site groundwater, the slurry wall and groundwater extraction system operating since March 2013 has been designed to reduce off-site migration of impacted groundwater.

8.3.1 On-Site Groundwater Remediation

The components of the groundwater remediation system are shown on Figure 5-5. Hydraulic head data measurements obtained on July 3, 2014 after 16 weeks continuous operation (average total pumping rate 25 gpm) show the effectiveness of the vertical barrier (slurry wall) and the depression effected by the recovery wells (Figure 8-1). Comparison of the July 3, 2014

potentiometric surface with head distributions mapped for October 2012 and April 2013 (before construction on the slurry wall and GWTS) show 6 to 13 feet of head loss across the slurry wall (i.e., heads 6 to 13 feet lower on the north downgradient side of the wall). This head loss is not a result of head buildup on the upgradient (south) side of the wall. Rather, mounded groundwater south of the wall is being extracted and heads are lower than prior to wall construction. The cause of the head loss across the wall is a sharp reduction in water levels along the north side of the slurry wall. This indicates the system is performing as designed—groundwater is being intercepted south of the slurry wall and being prevented from migrating off-site before treatment. The infiltration trenches are causing a diffuse zone of partial saturation which has not yet created a significant localized increase in heads on the south side of the wall.

The performance of the groundwater remediation system will be more comprehensively evaluated in a separate report to be submitted to NDEP under separate cover.

8.3.2 Off-Site Monitored Natural Attenuation Program

This section provides preliminary observations regarding monitored natural attenuation (MNA) of groundwater downgradient of the slurry wall / groundwater treatment system described above. This information is based on an initial review of data in the 2013 Annual Groundwater Monitoring Report (2013 GWMR) and October 2013 MNA monitoring. The evaluation in this section is preliminary in nature, and the entirety of the MNA evaluation proposed in the MNA work plan (Broadbent, April 15, 2013) will be provided in the 2014 Annual Groundwater Monitoring Report.

8.3.2.1 Work Performed

Implementation of the MNA work plan began with the October 2013 groundwater semi-annual monitoring event which included sampling of wells specified in the work plan. These wells comprise three “transects” (Proximal Transect A, Medial Transect B, and Distal Transect C) at which MNA parameters and performance calculations will be made as monitoring and reporting continues. Wells J2D2-R2 and TMPZ-108 are transect A, PC-067 on transect B, AA-11 mid-way between transect B and C, and AA-20 on transect C. The MNA work plan includes detail, and locations of, these transects and wells.

The October 2013 sampling was conducted prior to installation of the slurry wall and groundwater treatment system (GWTS). Those systems were installed during January – March 2014 with completion and startup on March 12, 2014. More recently, the March 2014 semi-annual monitoring event was completed. Data from the October sampling event is validated and available whereas data from the March event is not yet validated. The preliminary MNA observations discussed in this section are based on the 2013 Annual Groundwater Report (2nd semester 2012 and 1st semester 2013 data), and MNA specific “bio-trap” data collected as part of the 2nd semester 2013 sampling event.

8.3.2.2 MNA Initial Demonstration Phase

Section 9.2 of the MNA work plan discusses MNA evaluations expected to be available at the conclusion of the first year of sampling (“Initial Demonstration Phase”). These are evaluations that will be included in the 2014 Annual Groundwater Monitoring Report. MNA preliminary evaluations that are discussed in the following subsections include:

- Compound Specific Isotope Analysis (CSIA) – the MNA work plan indicates tetrachloroethene concentrations of 5 ug/L or higher must be present to allow accurate isotope measurement.
- The presence or absence of indigenous anaerobic and aerobic co-metabolic bacteria that are capable of degrading chlorinated solvents. Observations are made from the “bio-trap” data gathered during the October 2013 sample event.
- Initial observations from geochemical data with respect to conditions which may be favorable or unfavorable for natural attenuation.

8.3.2.3 CSIA Applicability

The MNA work plan specifies use of Compound Specific Isotope Analysis (CSIA) to assist in the evaluation of the extent to which biodegradation is occurring (MNA Work Plan, Section 6.3.1). The work plan indicates that PCE concentrations of 5 ug/L or more are desired for accurate isotope analyses via CSIA. Data reported and documented in the 2013 GWMR and DVSR indicate tetrachloroethene concentrations generally ranging from 52 ug/L to 84 ug/L at transect A wells; 16 – 18 ug/L at transect B, and 5.2 ug/L to 5.7 ug/L at transect C. This is a summary of data as reported in the 2013 GWMR well data tables for Second Semester 2011 thru First Semester 2013. This data indicates favorable tetrachloroethene concentrations for use of CSIA.

8.3.2.4 Indigenous Bacteria

The MNA work plan included use of “bio-traps” in three wells along the tetrachloroethene plume centerline (J2D2-R2, TMPZ-108, and PC-067). The bio-traps collect sample to quantify microbial population that aid in intrinsic biodegradation of chlorinated solvents. As detailed in the work plan, Dehalococcoides (DHC) is a bacterial population indicative of the potential for reductive dechlorination.

The first bio-trap sampling event was conducted as part of the Second Semester 2013 groundwater sampling event. The resulting data is included in the subsequent DVSR and will be reported in the 2014 Annual GWMR. An initial review of the bio-trap sampling results indicates an existing DHC population in the area of Transect A, and a lower level population in the area of Transect B. This first round data is encouraging in regards to the presence of a DHC population, although the population may be low in comparison to what might be considered optimal.

8.3.2.5 Geochemical Data

Initial characterization of the reductive environment of the groundwater can be made based on data reported in the 2013 Annual GWMR. A review of dissolved oxygen (DO), oxidation reduction potential (ORP), and pH reported for transect wells J2D2-R2, TMPZ-108, PC-067, and AA-20 is useful.

The aquifer pH at these locations is relatively neutral ranging between pH 6.9 to pH 7.3. This range of pH values will generally not encourage solubilization of metals which may be adsorbed to soil structures within the water-bearing zone.

DO values were variable across the well and transect areas in the Second Semester 2012 and First Semester 2013 sample events. DO measurements in the 1.0 mg/L range were recorded in the property line Transect A well TMPZ-108, with similar values at Transect B well PC-067, compared to measurements in the 6 mg/L range at well AA-20 (downgradient Transect C area). This data set indicates a low DO environment in the upgradient Transect A area compared to an aerobic higher DO condition down gradient in the Transect C area. However, the DO environment data is not in complete agreement as shown by a 6.4 mg/L DO result recorded at Transect A well TMPZ-108 in the earlier semester event. Changes to the DO environment are likely as monitoring continues post slurry wall/GWTS installation along with the temporary underground injection of treated water downgradient of the slurry wall.

ORP values vary across the transect areas in the two semester data review. The ORP values range from 16 to 60 during the 2nd semester 2012 event, and 95 to 220 during the 1st semester 2013 event. Although there is variation in the values, the initial conclusion that can be made is that these ORP values are indicative of a mildly reductive aquifer environment.

It is beyond the scope of this initial data review to further evaluate the broader set of geochemical data. However, this initial review provides insight of the existing geochemical conditions as they relate to metals solubility and reductive dechlorination in the aquifer. A more detailed review with broader set of data will be part of the 2014 Annual GWMR MNA discussion.

8.3.2.6 Summary of Initial MNA Observations

This initial review of existing data indicates a groundwater environment supportive of the MNA processes described in the MNA work plan. The data is indicative of a generally reductive environment containing desirable DHC bacteria. The groundwater environment appears supportive of metals adsorption. The data also indicates an order of magnitude reduction in tetrachloroethene concentrations in groundwater as it passes from Transect A to downgradient Transect C. All of these initial observations are supportive of MNA. Further evaluation of the MNA parameters discussed in the MNA work plan will be included in the 2014 GWMR.

9. Data Gaps

As suggested above, TIMET has proceeded (with NDEP review and concurrence) with remedial actions to eliminate potential exposure pathways, most notably the north site cover as detailed in the Soil Management Plan (GEI, 2014a) and reconstruction of the CSD Ponds (in the design stage). Therefore a quantitative risk assessment in order to support another remediation approach where pathways are not eliminated (e.g., no action or partial excavation alternatives) has not been completed.

The data generated for, and presented in, this CSM is sufficient to support the planned remediation (north site cover, J-2 cover and CSD Pond reconstruction) for elimination of exposure pathways. These remedial actions are planned for completion during 2014-2016.

Other areas of the site for which no remediation is currently planned due to lack of identified impacts may require additional sampling when a “No Further Action” determination is to be requested by TIMET (for example to accommodate new construction or Facility expansion). Data needs for such conditions will be addressed on a case by case basis.

SW-1 may be an area where additional investigation, sampling and remedial alternatives study is appropriate. Although the chemical composition of the material contained in SW-1 would not appear to pose a significant exposure potential, TIMET intends to stabilize this material such that the area poses no hazard and can potentially be productively used.

10. Recommendations for Additional Investigation and Remedial Action

TIMET intends to proceed with the North Site Cover, J-2 Landfill Cover and CSD Pond Reconstruction projects scheduled for completion during 2014-2016.

TIMET recommends that a plan be developed to investigate the feasibility of remediating SW-1 by stabilizing its contents and integrating it into the North Site Cover as appropriate.

Other than SW-1, no additional sampling is recommended at this time for general site characterization. If and when it becomes appropriate for TIMET to request “No Further Action” determinations from NDEP to address specific needs of the Facility (e.g., areas for expansion or divestiture), additional data collection may be appropriate on a case by case basis.

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